MCCLURE'S MAGAZINE.

VOL. III. SEPTEMBER, 1894. NO. 4.

MY FIRST BOOK—"TREASURE ISLAND."

By ROBERT LOUIS STEVENSON.

IT was far, indeed, from being my first book, for I am not a novelist alone. But I am well aware that my paymaster, the great public, regards what else I have written with indifference, if not aversion. If it call upon me at all, it calls on me in the familiar and indelible character; and when I am asked to talk of my first book, no question in the world but what is meant is my first novel.

Sooner or later, somehow, anyhow, I was bound I was to write a novel. It seems vain to ask why. Men are born with various manias: from my earliest childhood it was mine to make a plaything of imaginary series of events; and as soon as I was able to write, I became a good friend to the paper-makers. Reams upon reams must have gone to the making of "Rathillet," the "Pentland Rising,"* the "King's Pardon" (otherwise "Park Whitehead"), "Edward Darren," "A Country Dance," and a "Vendetta in the West;" and it is consolatory to remember that these reams are now all ashes, and have been received again into the soil. I have named but a few of my ill-fated efforts: only such, indeed, as came to a fair bulk ere they were desisted from; and even so they cover a long vista of years. "Rathillet" was attempted before fifteen, the "Vendetta" at twenty-nine, and the succession of defeats lasted unbroken till I was thirty-one. By that time I

LLOYD OSBOURNE, THE "SCHOOLBOY IN THE LATE MISS McGREGOR'S COTTAGE."

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* *Ne pas confondre.* Not the slim green pamphlet with the imprint of Andrew Elliott, for which (as I see with amazement from the booklists) the gentlemen of England are willing to pay fancy prices; but its predecessor, a bulky historical romance without a spark of merit, and now deleted from the world.

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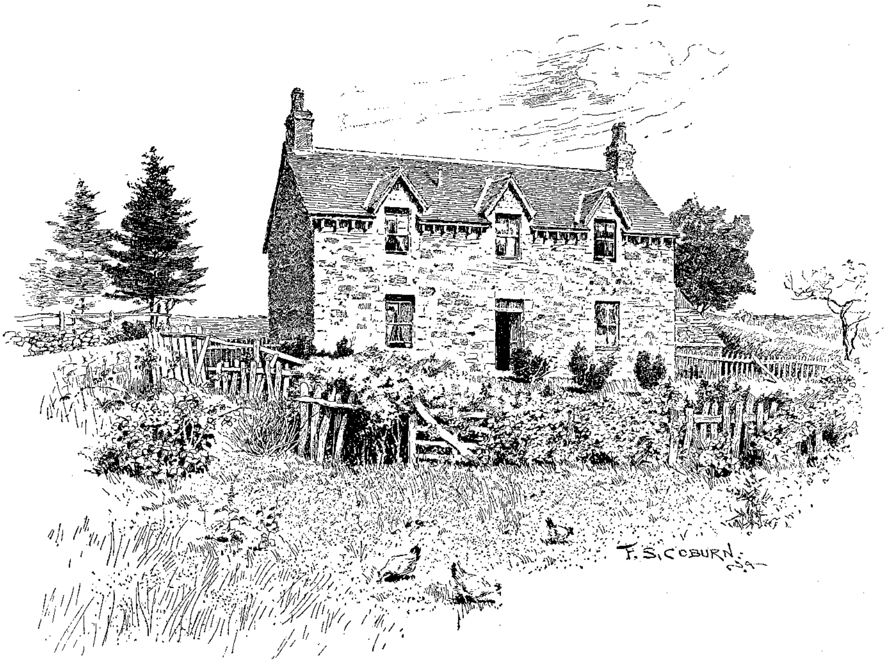
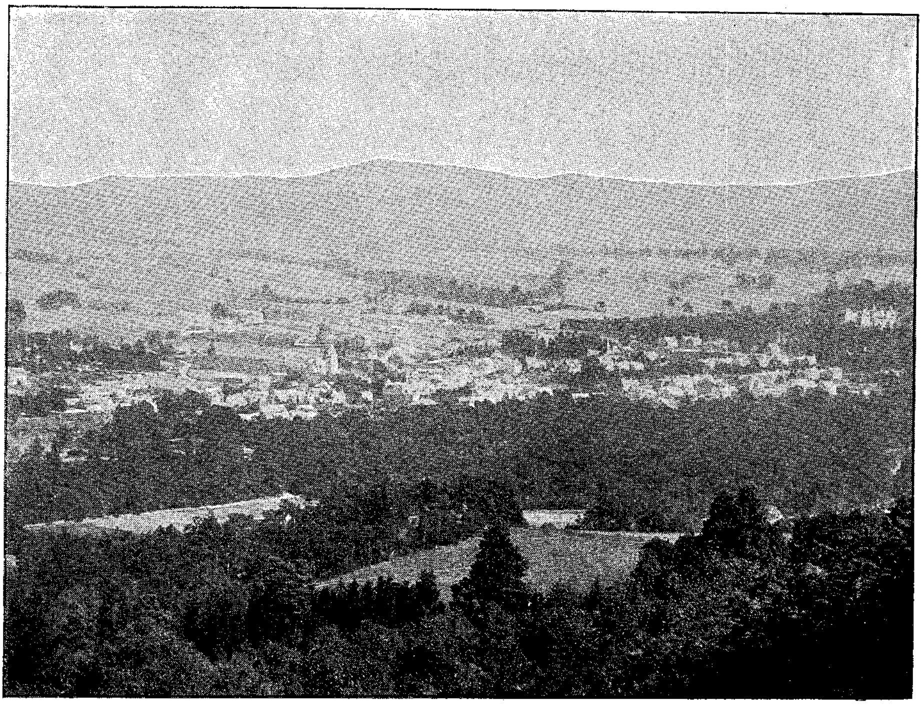
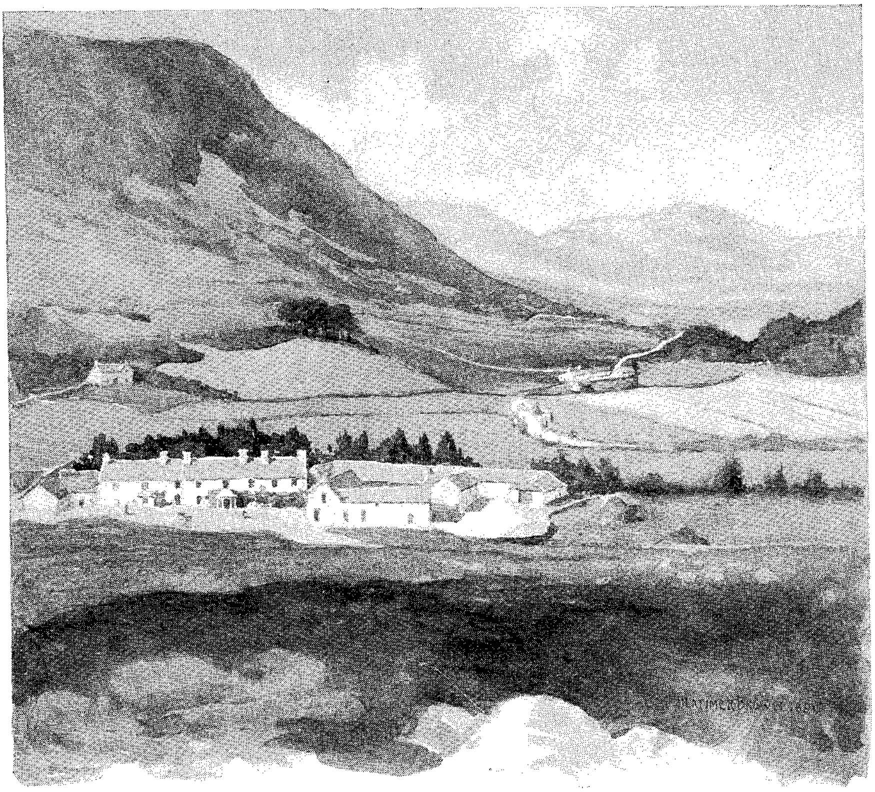


THE STEVENSON FAMILY COTTAGE ABOVE PITLOCHRY.



PITLOCHRY, A VILLAGE NEAR THE STEVENSON COTTAGE. FROM A PHOTOGRAPH BY G. W. WILSON & CO., ABERDEEN.

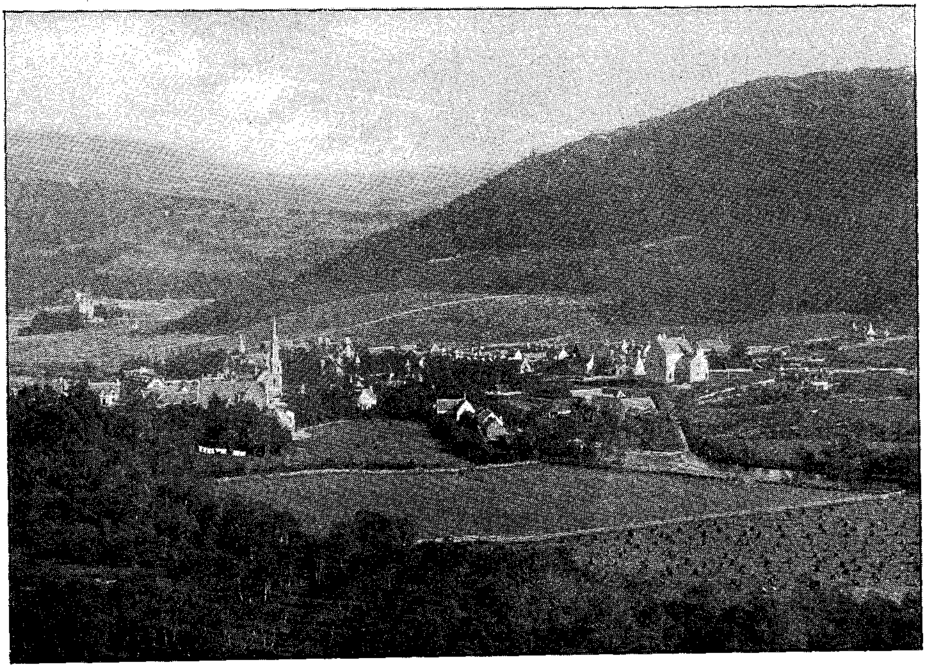


SPITTAL OF GLENSHEE.

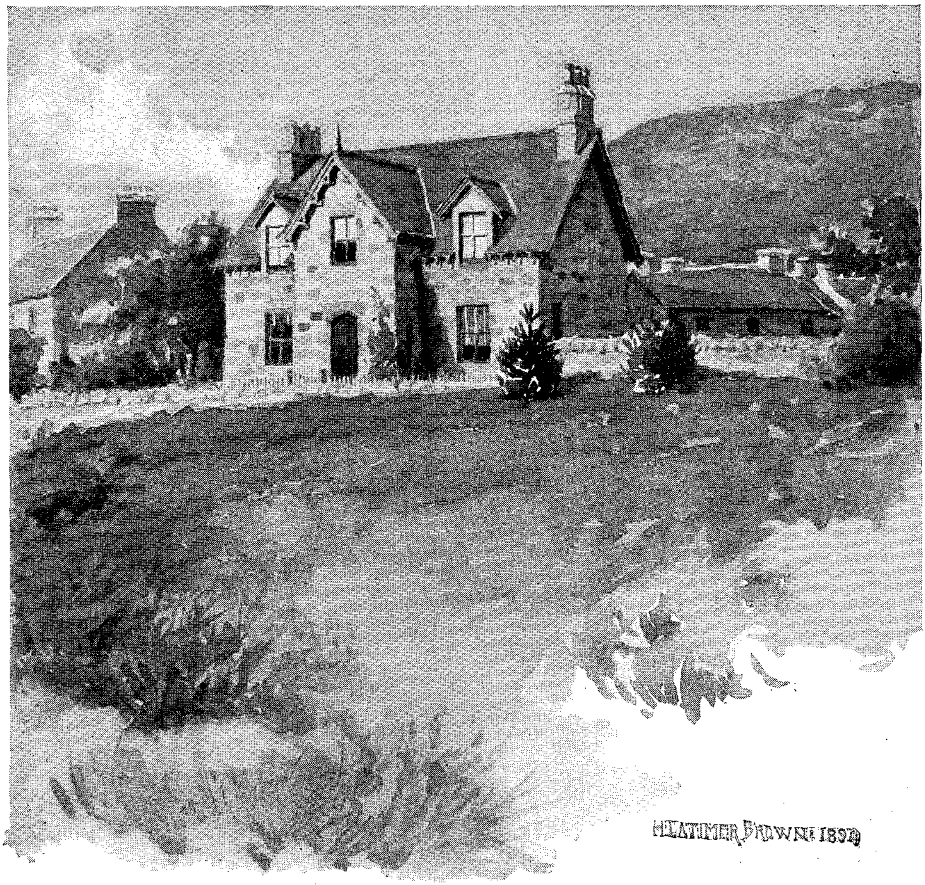
had written little books and little essays and short stories, and had got patted on the back and paid for them—though not enough to live upon. I had quite a reputation. I was the successful man. I passed my days in toil, the futility of which would sometimes make my cheek to burn,—that I should spend a man's energy upon this business, and yet could not earn a livelihood; and still there shone ahead of me an unattained ideal. Although I had attempted the thing with vigor not less than ten or twelve times, I had not yet written a novel. All—all my pretty ones—had gone for a little, and then stopped inexorably, like a schoolboy's watch. I might be compared to a cricketer of many years' standing who should never have made a run. Anybody can write a short story—a bad one, I mean—who has industry and paper and time enough; but not everyone may hope to write even a bad novel. It is the length that kills. The accepted novelist may take his novel up and put it down, spend days upon it in vain, and write not any more than he makes haste to blot. Not so the beginner. Human nature has certain rights; instinct—the instinct of self-preservation—forbids that any man (cheered and supported by the consciousness of no previous victory) should endure the miseries of unsuccessful literary toil beyond a period to be measured in weeks. There must be something for hope to feed upon. The beginner must have a slant of wind, a lucky vein must be running, he must be in one of those hours when the words come and the phrases balance of themselves—*even to begin*. And having begun, what a dread looking forward is that until the book shall be accomplished! For so long a time the slant is to continue unchanged, the vein to keep running; for so long a time you must hold at command the same quality of style;

for so long a time your puppets are to be always vital, always consistent, always vigorous. I remember I used to look, in those days, upon every three-volume novel with a sort of veneration, as a feat—not possibly of literature—but at least of physical and moral endurance and the courage of Ajax.

In the fated year I came to live with my father and mother at Kinnaird, above Pitlochry. There I walked on the red moors and by the side of the golden burn. The rude, pure air of our mountains inspirited, if it did not inspire us; and my wife and I projected a joint volume of bogie stories, for which she wrote "The Shadow on the Bed," and I turned out "Thrawn Janet," and a first draft of the "Merry Men." I love my native air, but it does not love me; and the end of this delightful period was a cold, a fly blister, and a migration, by Strathairdle and Glenshee, to the Castleton of Braemar. There it blew a good deal and rained in a proportion. My native air was more unkind than man's ingratitude; and I must consent to pass a good deal of my time between four walls in a house lugubriously known as "the late Miss McGregor's cottage." And now admire the finger of predestination. There was a schoolboy in the late Miss McGregor's cottage, home for the holidays, and much in want of "something craggy to break his mind upon." He had no thought of literature; it was the art of Raphael that received his fleeting suffrages, and with the aid of pen and ink and a shilling box of water colors, he had soon turned one of the rooms into a picture gallery. My more immediate duty towards the gallery was to be showman; but I would sometimes unbend a little, join the artist (so to speak) at the easel, and pass the afternoon with him in a generous emulation, making colored drawings. On one of these occasions I made the map of an island; it was elaborately and (I thought) beautifully colored; the shape of it took my fancy beyond expression; it contained harbors that pleased me like sonnets; and with the unconsciousness of the predestined, I ticketed my performance "Treasure Island." I am told there are people

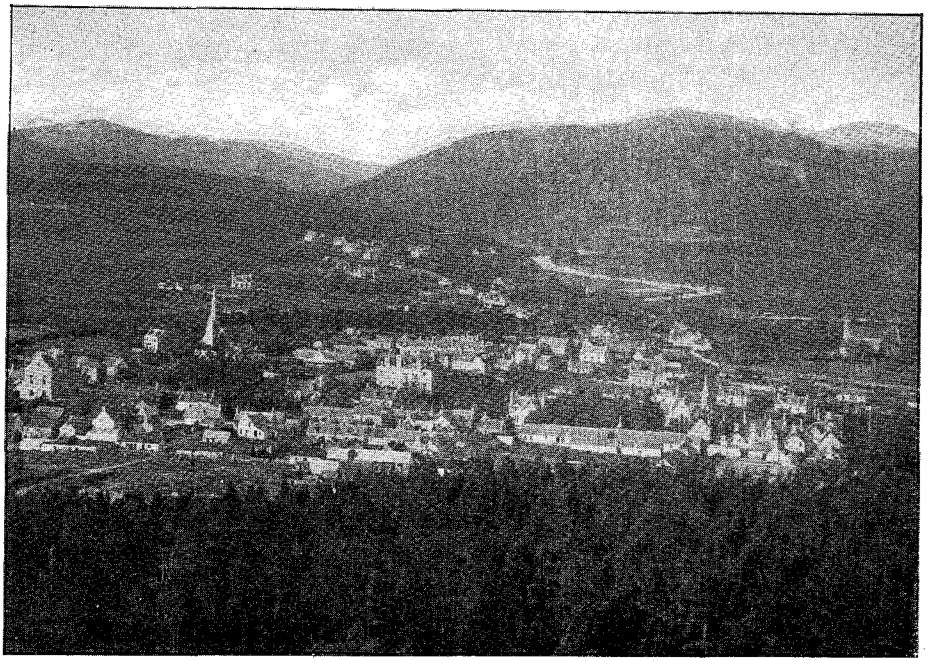


CASTLETON OF BRAEMAR, FROM MORRONE. PHOTOGRAPH BY G. W. WILSON & CO., ABERDEEN.



"THE LATE MISS McGREGOR'S COTTAGE," BRAEMAR.

who do not care for maps, and find it hard to believe. The names, the shapes of the woodlands, the courses of the roads and rivers, the prehistoric footsteps of man still distinctly traceable up hill and down dale, the mills and the ruins, the ponds and the ferries, perhaps the "Standing Stone" or the "Druidic Circle" on the heath; here is an inexhaustible fund of interest for any man with eyes to see, or twopence worth of imagination to understand with. No child but must remember laying his head in the grass, staring into the infinitesimal forest, and seeing it grow populous with fairy armies. Somewhat in this way, as I pored upon my map of "Treasure Island," the future characters of the book began to appear there visibly among imaginary woods; and their brown faces and bright weapons peeped out upon me from unexpected quarters, as they passed to and fro, fighting, and hunting treasure, on these few square inches of a flat projection. The next thing I knew, I had some paper before me and was writing out a list of chapters. How often have I done so, and the thing gone no farther! But there seemed elements of success about this enterprise. It was to be a story for boys; no need of psychology or fine writing; and I had a boy at hand to be a touchstone. Women were excluded. I was unable to handle a brig (which the "Hispaniola" should have been), but I thought I could make shift to sail her as a schooner without public shame. And then I had an idea for John Silver from which I promised myself funds of entertainment: to take an admired friend of mine (whom the reader very likely knows and ad-



BRAEMAR, FROM CRAIG COYNACH. PHOTOGRAPH BY G. W. WILSON & CO., ABERDEEN.

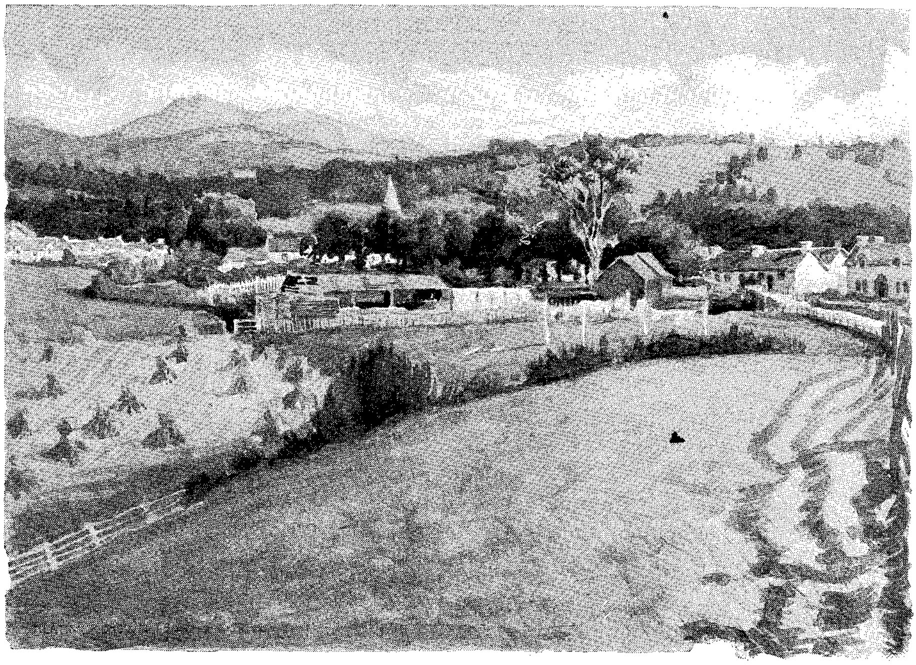
mires as much as I do), to deprive him of all his finer qualities and higher graces of temperament, to leave him with nothing but his strength, his courage, his quickness, and his magnificent geniality, and to try to express these in terms of the culture of a raw tarpaulin. Such psychical surgery is, I think, a common way of "making character;" perhaps it is, indeed, the only way. We can put in the quaint figure that spoke a hundred words with us yesterday by the wayside; but do we know him? Our friend, with his infinite variety and flexibility, we know—but can we put him in? Upon the first we must engraft secondary and imaginary qualities, possibly all wrong; from the second, knife in hand, we must cut away and deduct the needless arborescence of his nature; but the trunk and the few branches that remain we may at least be fairly sure of.

On a chill September morning, by the cheek of a brisk fire, and the rain drumming on the window, I began the "Sea Cook," for that was the original title. I have begun (and finished) a number of other books, but I cannot remember to have sat down to one of them with more complacency. It is not to be wondered at, for stolen waters are proverbially sweet. I am now upon a painful chapter. No doubt the parrot once belonged to Robinson Crusoe. No doubt the skeleton is conveyed from Poe. I think little of these, they are trifles and details; and no man can hope to have a monopoly of skeletons or make a corner in talking birds. The stockade, I am told, is from "Masterman Ready." It may be, I care not a jot. These useful writers had fulfilled the poet's saying: departing, they had left behind them

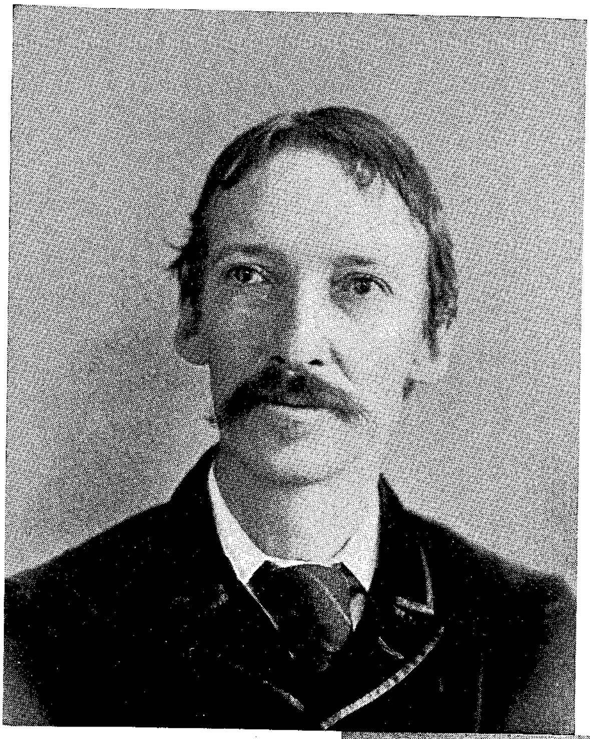
"Footprints on the sands of time;
Footprints that perhaps another——"

and I was the other! It is my debt to Washington Irving that exercises my conscience, and justly so, for I believe plagiarism was rarely carried farther. I chanced to pick up the "Tales of a Traveller" some years ago, with a view to an anthology of prose narrative, and the book flew up and struck me: Billy Bones, his chest, the company in the parlor, the whole inner spirit and a good deal of the material detail of my first chapters—all were there, all were the property of Washington Irving. But I had no guess of it then as I sat writing by the fireside, in what seemed the springtides of a somewhat pedestrian inspiration; nor yet day by day, after lunch, as I read aloud my morning's work to the family. It seemed to me original as sin; it seemed to belong to me like my right eye. I had counted on one boy; I found I had two in my audience. My father caught fire at once with all the romance and childishness of his original nature. His own stories, that every night of his life he put himself to sleep with, dealt perpetually with ships, roadside inns, robbers, old sailors, and commercial travellers before the era of steam. He never finished one of these romances: the lucky man did not require to! But in "Treasure Island" he recognized something kindred to his own imagination; it was *his* kind of picturesque; and he not only heard with delight the daily chapter, but set himself actively to collaborate. When the time came for Billy Bones's chest to be ransacked, he must have passed the better part of a day preparing, on the back of a legal envelope, an inventory of its contents, which I exactly followed; and the name of "Flint's old ship," the "Walrus," was given at his particular request. And now, who should come dropping in, *ex machina*, but Dr. Jaap, like the disguised prince who is to bring down the curtain upon peace and happiness in the last act, for he carried in his pocket not a horn or a talisman, but a publisher; had, in fact, been charged by my old friend Mr. Henderson to unearth new writers for "Young Folks." Even the ruthlessness of a united family recoiled before the extreme measure of inflicting on our guest the mutilated members of the "Sea Cook;" at the same time we would by no means stop our readings, and accordingly the tale was begun again at the beginning, and solemnly redelivered for the benefit of Dr. Jaap. From that moment on I have thought highly of his critical faculty; for when he left us, he carried away the manuscript in his portmanteau.

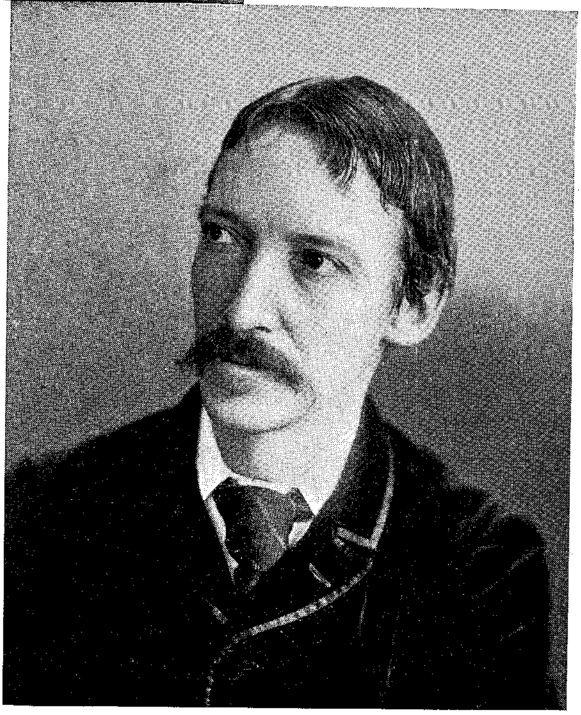
Here, then, was everything to keep me up—sympathy, help, and now a



MOULIN, ANOTHER VILLAGE NEAR THE STEVENSON COTTAGE. THIS VIEW IS FROM THE SOUTH.



bosom ; and here were the proofs of the beginning already waiting me at the "Hand and Spear!" There I corrected them, living for the most part alone, walking on the heath at Weybridge in dewy autumn mornings, a good deal pleased with what I had done, and more appalled than I can depict to you in words at what remained for me to do. I was thirty-one ; I was the head of a family ; I had lost my health ; I had never yet paid my way, had never yet made two hundred pounds a year ; my father had quite recently bought back and cancelled a book that was judged a failure ; was this to be another and last fiasco? I was indeed very positive engagement. I had chosen besides a very easy style. Compare it with the almost contemporary "Merry Men ;" one may prefer the one style, one the other—'tis an affair of character, perhaps of mood ; but no expert can fail to see that the one is much more difficult, and the other much easier, to maintain. It seems as though a full-grown, experienced man of letters might engage to turn out "Treasure Island" at so many pages a day, and keep his pipe alight. But alas ! this was not my case. Fifteen days I stuck to it, and turned out fifteen chapters ; and then, in the early paragraphs of the sixteenth, ignominiously lost hold. My mouth was empty ; there was not one word more of "Treasure Island" in my



ROBERT LOUIS STEVENSON.*

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* These and the three following portraits of Mr. Stevenson are from photographs taken in Australia in 1893, all near together.—ED. McCLURE'S MAGAZINE.

close on despair; but I shut my mouth hard, and during the journey to Davos, where I was to pass the winter, had the resolution to think of other things, and bury myself in the novels of M. du Boisgobey. Arrived at my destination, down I sat one morning to the unfinished tale, and behold! it flowed from me like small talk; and in a second tide of delighted industry, and again at the rate of a chapter a day, I finished "Treasure Island." It had to be transacted almost secretly. My wife was ill, the schoolboy remained alone of the faithful, and John Addington Symonds (to whom I timidly mentioned what I was engaged on) looked on me askance. He was at that time very eager I should write on the "Characters" of Theophrastus, so far out may be the judgments of the wisest men. But Symonds (to be sure) was scarce the confidant to go to for sympathy in a boy's story. He was large-minded; "a full man," if there ever was one; but the very name of my enterprise would suggest to him only capitulations of sincerity and solecisms of style. Well, he was not far wrong.

"Treasure Island"—it was Mr. Henderson who deleted the first title, "The Sea Cook"—appeared duly in the story paper, where it figured in the ignoble midst without woodcuts, and attracted not the least attention. I did not care. I liked the tale myself, for much the same reason as my father liked the beginning: it was my kind of picturesque. I was not a little proud of John Silver also, and to this day rather admire that smooth and formidable adventurer. What was infinitely more exhilarating, I had passed a landmark; I had finished a tale, and written "The End" upon my manuscript, as I had not done since the "Pentland Rising," when I was a boy of sixteen, not yet at college. In truth it was so by a set of lucky accidents: had not Dr. Jaap come on his visit, had not the tale flowed from me with singular ease, it must have been laid aside like its predecessors, and found a circuitous and unlamented way to the fire. Purists may suggest it would have been better so. I am not of that mind. The tale seems to have given much pleasure, and it brought (or was the means of bringing) fire and food and wine to a deserving family in which I took an interest. I need scarce say I mean my own.

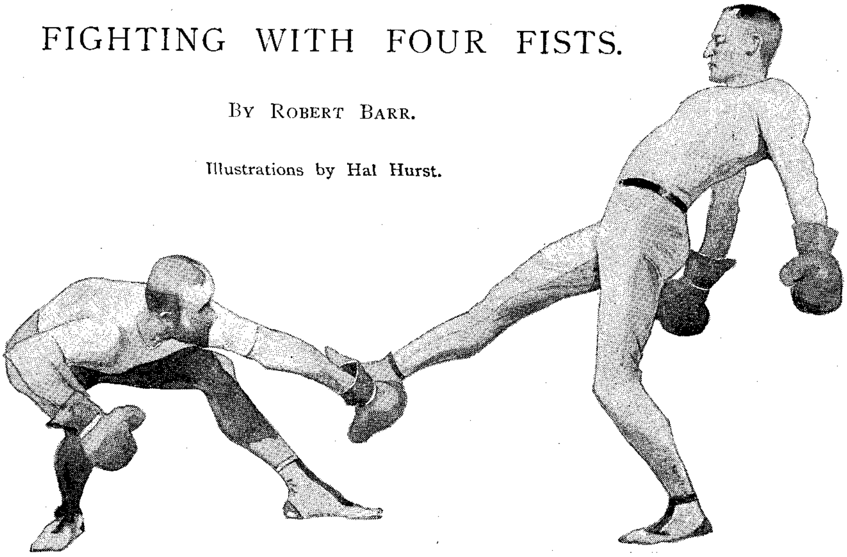
But the adventures of "Treasure Island" are not yet quite at an end. I had written it up to the map. The map was the chief part of my plot. For instance, I had called an islet "Skeleton Island," not knowing what I meant, seeking only for the immediate picturesque; and it was to justify this name that I broke into the gallery of Mr. Poe and stole Flint's pointer. And in the same way, it was because I had made two harbors that the "Hispaniola" was sent on her wanderings with Israel Hands. The time came when it was decided to republish, and I sent in my manuscript and the map along with it to Messrs. Cassell. The proofs came, they were corrected, but I heard nothing of the map. I wrote and asked; was told it had never been received, and sat aghast. It is one thing to draw a map at random, set a scale in one corner of it at a venture, and write up a story to the measurements. It is quite another to have to examine a whole book, make an inventory of all the allusions contained in it, and with a pair of compasses painfully design a map to suit the data. I did it, and the map was drawn again in my father's office, with embellishments of blowing whales and sailing ships; and my father himself brought into service a knack he had of various writing, and elaborately *forged* the signature of Captain Flint and the sailing directions of Billy Bones. But somehow it was never "Treasure Island" to me.

I have said it was the most of the plot. I might almost say it was the whole. A few reminiscences of Poe, Defoe, and Washington Irving, a copy of Johnson's "Buccaneers," the name of the Dead Man's Chest from Kingsley's "At Last," some recollections of canoeing on the high seas, a cruise in a fifteen-ton schooner yacht, and the map itself with its infinite, eloquent suggestion, made up the whole of my materials. It is perhaps not often that a map figures so largely in a tale; yet it is always important. The author must know his countryside, whether real or imaginary, like his hand; the distances, the points of the compass, the place of the sun's rising, the behavior of the moon, should all be beyond cavil. And how troublesome the moon is! I have come to grief over the moon in "Prince Otto;" and, so soon as that was pointed out to me, adopted a precaution which I recommend to other men—I never write now without an almanac. With an almanac, and the map of the country and the plan of every house, either actually plotted on paper or clearly and immediately apprehended in the mind, a man may hope to avoid some of the grossest possible blunders. With the map before him, he will scarce allow the sun to set in the east, as it does in the "Antiquary." With the almanac at hand, he will scarce allow two horsemen, journeying on the most urgent affair, to employ six days, from three of the Monday morning till late in the Saturday night, upon a journey of, say, ninety or a hundred miles; and before the week is out, and still on the same nags, to cover fifty in one day, as he may read at length in the inimitable novel of "Rob Roy." And it is certainly well, though far from necessary, to avoid such *croppers*. But it is my contention—my superstition, if you like—that he who is faithful to his map, and consults it, and draws from it his inspiration, daily and hourly, gains positive support, and not mere negative immunity from accident. The tale has a root there; it grows in that soil; it has a spine of its own behind the words. Better if the country be real, and he has walked every foot of it and knows every milestone. But, even with imaginary places, he will do well in the beginning to provide a map. As he studies it, relations will appear that he had not thought upon. He will discover obvious though unsuspected shortcuts and footpaths for his messengers; and even when a map is not all the plot, as it was in "Treasure Island," it will be found to be a mine of suggestion.

FIGHTING WITH FOUR FISTS.

By Robert Barr.

Illustrations by Hal Hurst.



NO. 1.—COUP DE SAVATE EVADED AND RETURNED BY CATCHING THE ADVERSARY'S FOOT AND ENDEAVORING TO THROW HIM BACKWARDS (AFTER A PHOTOGRAPH).

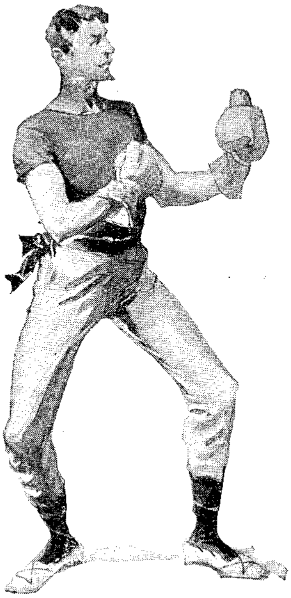
AN artist friend of mine, whose statuary now adorns the Hotel de Ville of a large Western city, was once studying in Paris. A question of etiquette arose between him and a French student. When the discussion had reached such a point that words failed to deal with it, it was unanimously agreed that the dispute should be referred for final settlement to a ring outside in the courtyard. Few Americans are expert with their fists, but my friend possessed that comfortable English theory, which had doubtless descended to him from his forefathers, relative to the number of Frenchmen that can be conveniently dealt with by one Anglo-Saxon. So, on reaching the courtyard, he struck the correct attitude for putting his theory into practice. The poet remarks :

"Thrice armed is he who hath his quarrel just,"

and the flippant man has added :

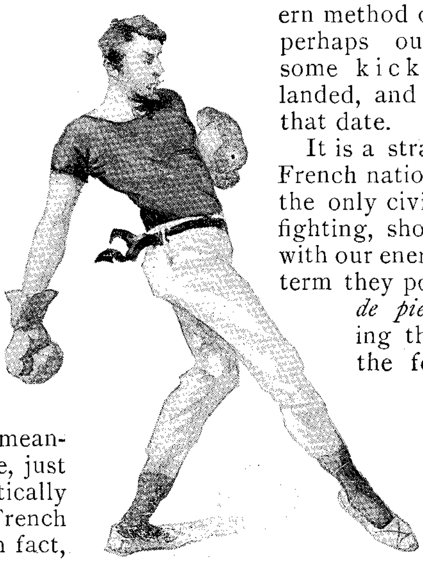
"But four times he who gets his blow in fust."

It proved so in this case, for before the American knew the battle had begun, he received a terrific kick that simply doubled him up. He stretched himself across a bench and waited for his second wind, which was a long time in coming. I regret to have to add that the American was not satisfied with what he received ; that he again faced his foe, and this time caught the foot, and then the Frenchman, whom he flung over his head, bringing him down on the pavement with a crash that ended the fight for some days. Now, each of these students thought that the other had not fought fairly. It is hard to make an Englishman believe that a kick, however delivered, is legitimate fighting. The Frenchman's point of view is different. He thinks that if a man is set upon by two or three ruffians, the person so attacked should be able to defend himself with all the limbs he has. The use of the foot, therefore, has been brought down to a system in France, and I was astonished to find, on investigating this subject, that many English boxers have a great admiration for the French "savate," and in each of the boxing schools I visited in Paris I saw several Englishmen being trained to wield the light fantastic toe in a way that would make



NO. 2.—SQUARING UP.

Miss Lottie Collins shudder. I never use the foot in fighting, except to aid me in putting as great a distance between my opponent and myself as possible. My fists I never use at all; and, knowing absolutely nothing about the boxing of any country, I am therefore in a position to write calmly and dispassionately on the subject of the French savate. "Savate" literally means "old shoe," but in French boxing parlance it has come to mean the kick scientifically delivered. The reason of this is, doubtless, because the kick was first used in settling the quarrels of *souteneurs*, or bullies, and by the *habitués* of Barrier Balls. Their old shoes did marvellous execution, and so the name has been retained now that professors of the art of kicking have reduced it to a science. The savate is a comparatively modern method of attack, although perhaps our forefathers did some kicking when Cæsar landed, and off and on since that date.

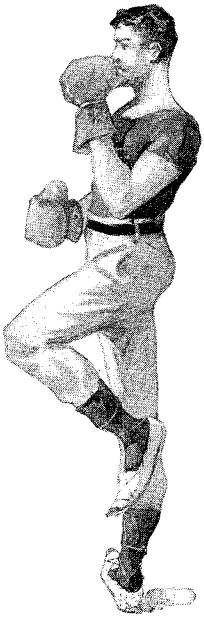


NO. 3.—FIRST KICK, COUP DE SAVATE.

It is a strange thing that the French nation, which is perhaps the only civilized nation using the foot in legitimate fighting, should have no one word that corresponds with our energetic monosyllable "kick." The nearest term they possess is the three-worded phrase *coup de pied.* Thus they are driven in characterizing the play of the foot to words that relate to the foot, but which do not at all correspond with our terse word "kick." The *chausson,* meaning a sock or a light shoe, just as you choose, has practically the same significance in French boxing as "savate:" in fact, it is considered less vulgar than the latter term.

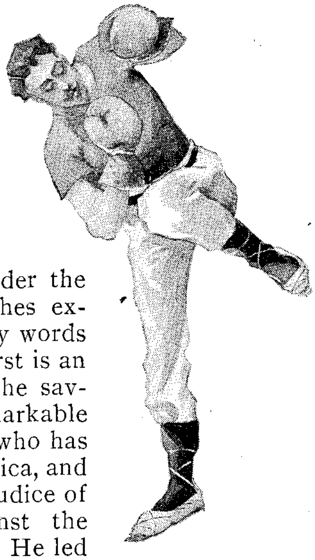
In 1830 the most celebrated master of the kick was Michell. Michell went in for a sharp, nervous, but plain kick, that was eminently practical for outdoor use, though lacking the airy grace which has since been added, and which makes the savate a thing of delight for a nice, quiet drawing-room entertainment.

Afterwards, the three L.'s did much to put various ornaments on the old shoe. These professors were Lozes of Toulouse, Lecour of Paris, and Leboucher of Rouen. Staid old London itself had something to do with the formation of the present brilliant French kick. Charles Lecour came over to England to learn what he could of English boxing, and took lessons from Swift and Adams. In London Lecour probably pranced around his room and invented new kicks, to the astonishment of the person who brought in his tea. Thus did the French professors build up the science of savate, adding a loving touch here and a modern improvement there, until it has become a glittering and bewilder-



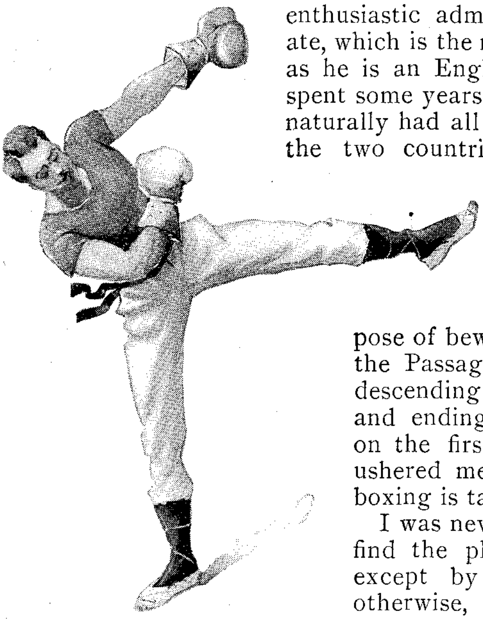
NO. 4.—PARRY FOR FIRST KICK.

ing art that carries confusion into the ranks of the enemy. We have now the low kick on the shin, the heel kick on the body, the toe kick on the side of the head, and the ferocious *tournant* kick that, to misquote Shakespeare, is ever so much more blessed to give than to receive, blessing him who gives, but decidedly doing the other thing for the man who takes, landing him right into the very centre of next week.



NO. 5.—FIRST POSITION, COUP DE FLANC.

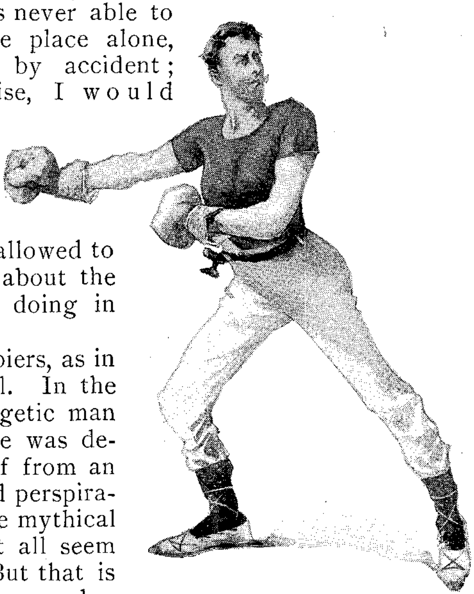
I went over to Paris for the purpose of bearding the savate in its den, and placed myself under the chaperonage of Mr. Hurst, whose spirited sketches explain the antics of this art so much better than any words of mine can do. Mr. Hurst is an enthusiastic admirer of the savate, which is the more remarkable as he is an Englishman who has spent some years in America, and naturally had all the prejudice of the two countries against the kick. He led me through a labyrinth of those passages which Paris has provided herself with for the manifest purpose of bewildering a stranger; beginning with the Passage Jouffroy, threading its turns and descending its steps, crossing a small street, and ending with the Passage Verdeau, where, on the first floor of number something *bis*, he ushered me into the Salle d'Armes where the boxing is taught.



NO. 6.—SECOND POSITION, COUP DE FLANC.

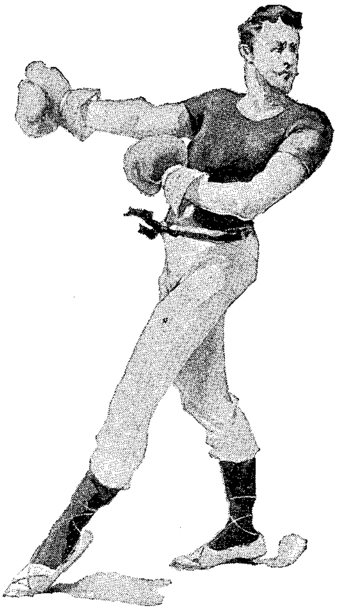
I was never able to find the place alone, except by accident; otherwise, I would know more about the savate than I do, for I missed several appointments there. Unfortunately for me, cabmen are not allowed to drive along the passages, which is about the only thing they are prohibited from doing in Paris.

The Salle was wainscoted with rapiers, as in the daytime it was a fencing school. In the corner of the room a small but energetic man was kicking savagely at nothing. He was delivering a low kick, guarding himself from an imaginary foe, with determination and perspiration on his face, bringing to the whole mythical encounter a seriousness that made it all seem immensely ridiculous to a stranger. But that is the way perfection is attained. If anyone believes the kick is acquired without nearly as



NO. 7.—FIRST POSITION, CHASSÉ CROISÉ (CROSS KICK).

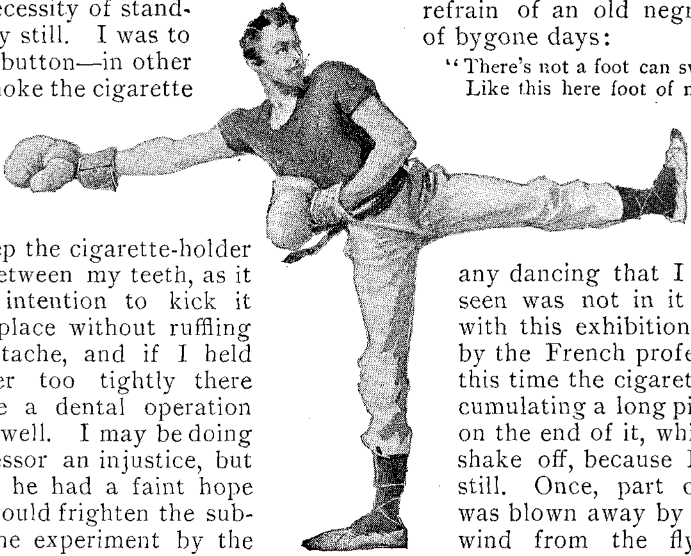
much teaching and practice as piano-playing, he is mistaken. The professor stood over six feet tall, a powerful, well-proportioned man, who, notwithstanding his size, was as light and airy on his feet as a dancing-master. At the request of the artist, he gave me some specimens of the accuracy of aim of the savate.



NO. 8.—SECOND POSITION, CHASSÉ CROISÉ.

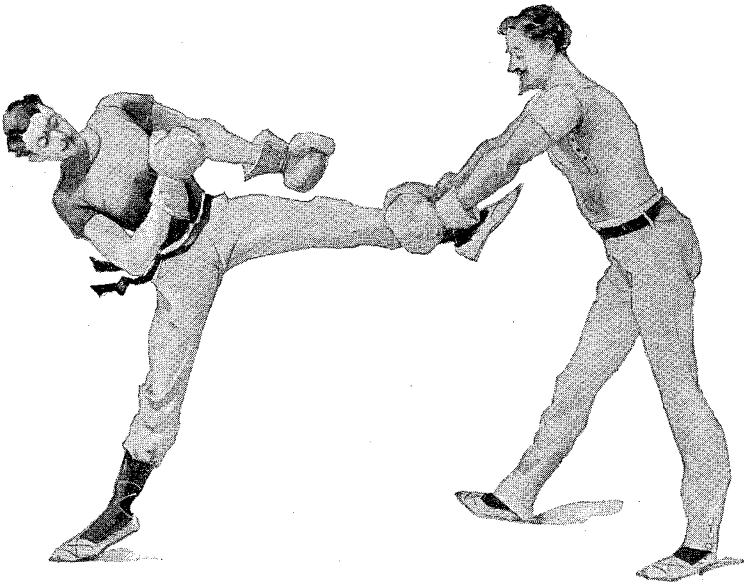
The professor was William Tell, with his foot as the weapon, instead of a bow and arrow; I was the unfortunate boy, with a cigarette in my mouth, instead of an apple on my head. The professor impressed upon me the necessity of standing rigidly still. I was to press the button—in other words, smoke the cigarette—and he would do the rest. He asked me to keep the cigarette-holder loosely between my teeth, as it was his intention to kick it from its place without ruffling the moustache, and if I held the holder too tightly there might be a dental operation added as well. I may be doing the professor an injustice, but I suspect he had a faint hope that he would frighten the subject of the experiment by the general glitter of his foot-play; but, knowing that I was, in a measure, a guest of the Salle d'Armes, I presumed it would not be etiquette to knock me through the partition, or make me sing with the poet, "But why did you kick me down stairs?" I, therefore, resolved to give a sample of Saxon stolidity which would be remotely a counterpart of his Latin agility. I planted myself solidly on my two feet, while the professor poised lightly on his one. After a few preliminary passes, the foot began to dart hither and thither in apparently the most reckless manner, coming sometimes with appalling energy full tilt toward my face, but just missing my cheek by the eighth of an inch; then over the head, under the chin, now on one side, now on the other, playing around my head like summer lightning. All the time there was running through my mind with the persistence of "Punch, brothers, punch with care," the refrain of an old negro melody of bygone days:

"There's not a foot can swing a boot
Like this here foot of mine."



NO. 9.—THIRD POSITION, CHASSÉ CROISÉ.

The negro referred to dancing, but any dancing that I have ever seen was not in it compared with this exhibition of savate by the French professor. All this time the cigarette was accumulating a long piece of ash on the end of it, which did not shake off, because I stood so still. Once, part of the ash was blown away by a whiff of wind from the flying foot. When this brilliant and ornamental foot-play was finished, the professor announced that he would now attend to the cigarette in three passes, each one different, and again asked me to press loosely on the holder with my teeth. First, with a straight kick, he knocked the ashes off; then, with a downward pass, he struck the cigarette from the holder to the floor; finally, with an upward whisk of

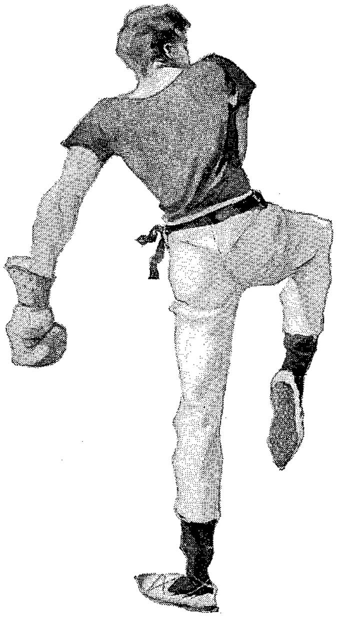


NO. 10.—RUNNING CHASSÉ CROISÉ, SHOWING THE METHOD OF PARRYING.

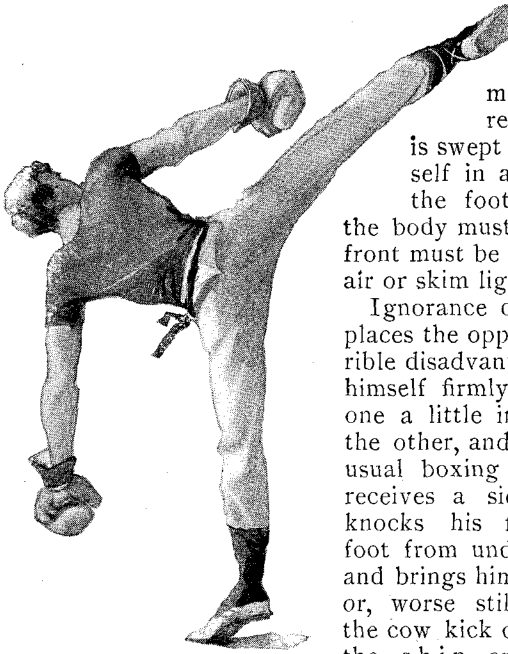
the foot, he sent the holder whirling to the ceiling, caught it deftly as it came down, and presented it to me with a flourish that would have done credit to Beau Nash. All this struck me as very wonderful, but I ventured to suggest that if a man did this sky work with his foot, a real opponent could easily, with a quick movement, push him over, standing, as he did, on one leg.

"Try it," said the professor, kindly. I think, if it is all the same to the reader, I will pass lightly over my disastrous attempt to upset a man who stood only on one leg. I fell an easy victim to the flying foot, which swept my own from under me with a suddenness that was a great surprise to me at the time, and a subject of sad remembrance afterwards. The shoemaker should stick to his last. I was somewhat consoled, however, when I saw one of the most stalwart men in the school fail to push the professor over, even when he succeeded in imprisoning the foot that was doing the kicking.

One of the first things to be learnt in attaining the art of savate, and apparently one of the most difficult to learn and to remember, is that the weight of the body must be supported by the hind leg, if the use of such a term is permissible. The foot that is farthest to the rear must always bear the weight of the body. When, as in some of the movements, the feet constantly change places, the novice finds it difficult to remember that in no instance is the foot farthest forward to



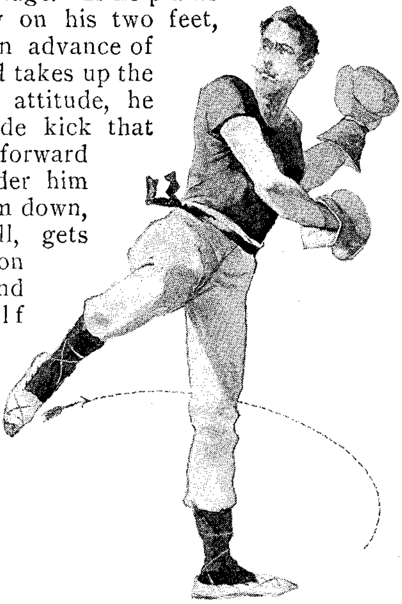
NO. 11.—FIRST POSITION, COUP FONDAMENTAUX.



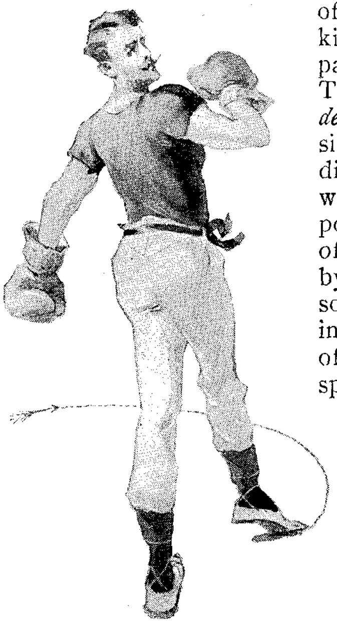
NO. 12.—SECOND POSITION, COUP FONDAMENTAUX.

bear any of the body's weight. If he takes the liberty of forgetting this axiom for a moment, it is generally brought to his recollection when his forward foot is swept from under him, and he finds himself in a heap on the floor. As often as the foot shifts to the rear, the weight of the body must be shifted upon it. The foot in front must be entirely free to wave about in the air or skim lightly over the floor.

Ignorance of the primary rule of the savate places the opponent of a French boxer at a terrible disadvantage. If he plants himself firmly on his two feet, one a little in advance of the other, and takes up the usual boxing attitude, he receives a side kick that knocks his forward foot from under him and brings him down, or, worse still, gets the cow kick on the shin and finds himself with a broken leg. When the pupil has had a few tumbles, and begins to realize the importance of not resting any of his weight on his forward foot, he is initiated into the mysteries of the low kick and the parry thereof. This, the *coup de savate*, is simply an ordinary kick, with the toe pointing out and downward, aimed at the shin of the opponent, as shown in No. 3, and is parried by "bending the pregnant hinges of the knee," so as to bring the foot up and back, as shown in No. 4. There are, of course, different methods of dealing with the *coup de savate*. A man may spring forward over the extended foot and deal the kicker a right-handed blow on the head (No. 19), or he may spring back, stoop, and endeavor to throw the kicker over backward by flinging up his extended foot.

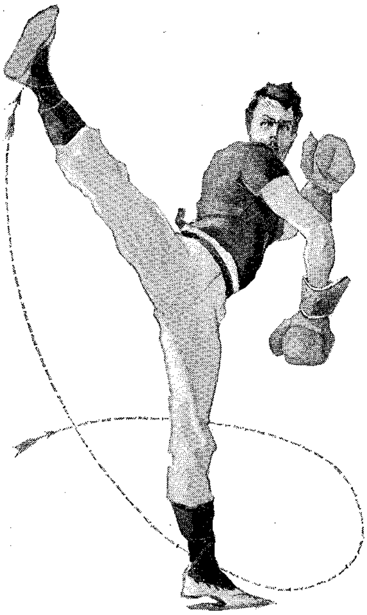


NO. 13.—COUP DE PIED TOURNANT. FIRST POSITION, IMMEDIATELY AFTER PARRY FROM ADVERSARY.



NO. 14.—COUP DE PIED TOURNANT. SECOND POSITION.

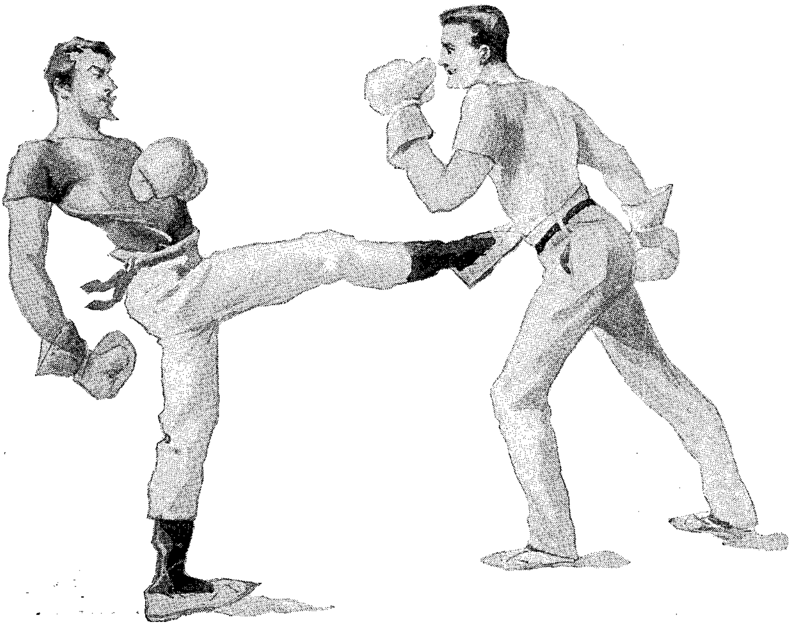
Next we come to the side kick, the *coup de flanc*. This may be a high or a low kick, and may attack the face, the side, or the chest. In the *coup de savate* the toe hits the opponent; in the *coup de flanc* the heel strikes. When the point of attack is the chest, the parry is



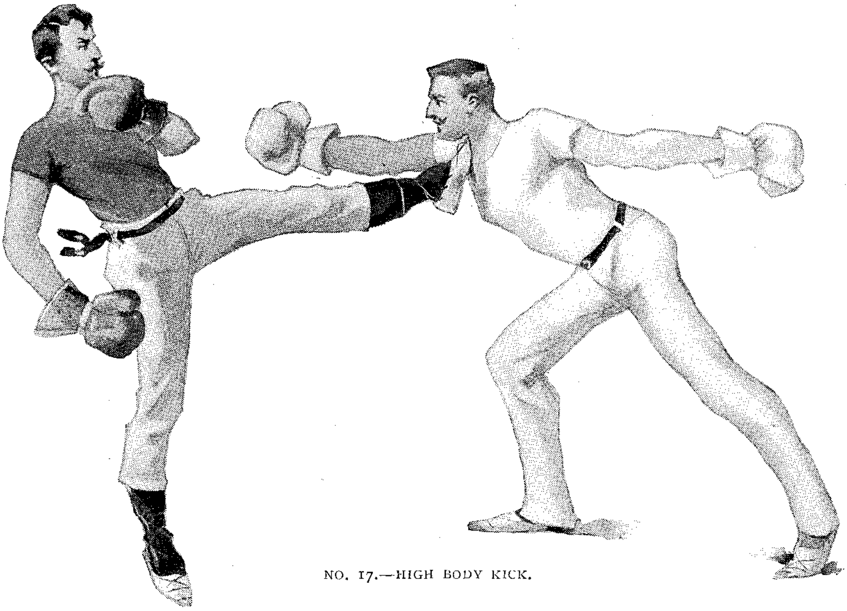
NO. 15.—COUP DE PIED TOURNANT. THIRD POSITION.

given by drawing the body back and bringing down both arms on the extended foot. When the point of attack is the face, the parry is the reverse of this. The kicker's opponent strikes up the foot, and endeavors to throw the attacker over on his back. When the *coup de flanc* is aimed at the side, the foot is thrown to the right or the left by the man defending. He does this by a sweep of the arm, and it is a very dangerous parry, as will be seen when we come to consider the kick which follows. The first and second positions of the *coup de flanc* are seen in Nos. 5 and 6.

The danger of the parry to the right or left arises from the fact that this parry forces the *coup de pied tournant*, probably the most effective and terrible kick in the list. It comes with lightning-like rapidity, requiring an entirely different parry from the one just given, and from which the defender rarely gets time to recover before the *tournant* is delivered with terrific force. In fact, the first kick is often given for the purpose of having the second forced by the parry of the first. When the defender flings the attacker's foot to the right or left, the latter takes the momentum thus given, whirls around like a flash, and delivers the *coup de pied tournant*. The movement is shown by the figures and dotted lines in Nos. 13, 14, and 15. The best parry for that kick is to get out of its way. This,



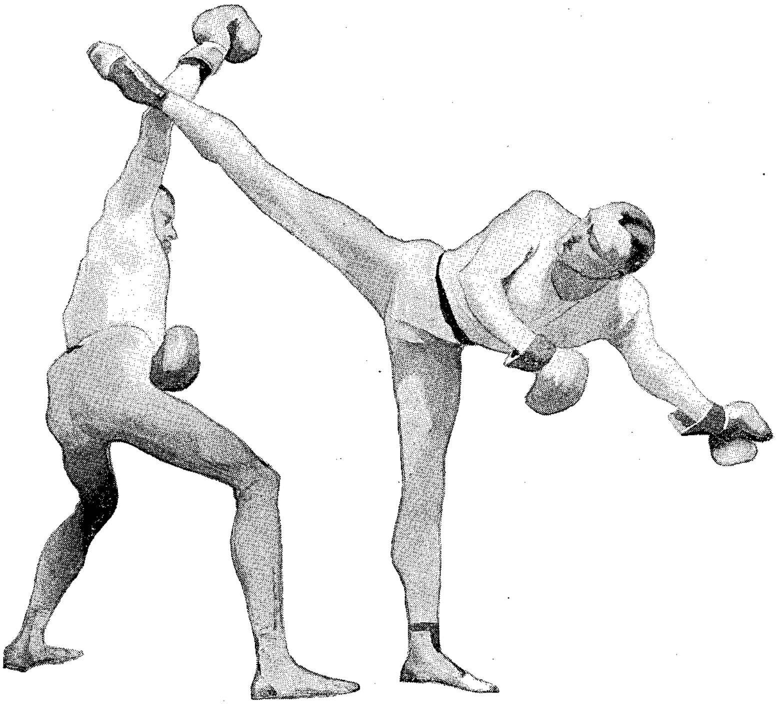
NO. 16.—BELT KICK (GIVEN ON FIRST SIGNS OF ADVERSARY'S ATTACK).



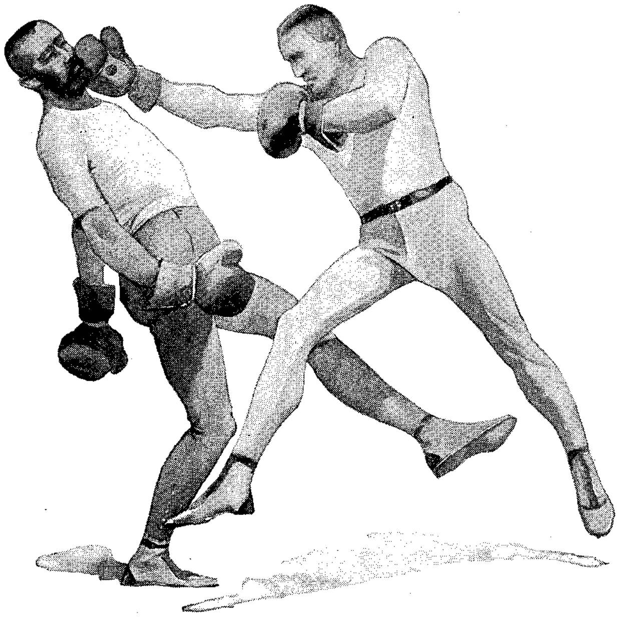
NO. 17.—HIGH BODY KICK.

however, is merely an expression of private opinion, and is the parry I would use if I were confronted by such a kick. The person attacked parries either by the upward or downward sweep of the arms, depending on whether the kick is delivered at the face or at the chest.

The *chassé croisé*, or cross kick, is another vicious specimen of the savate.



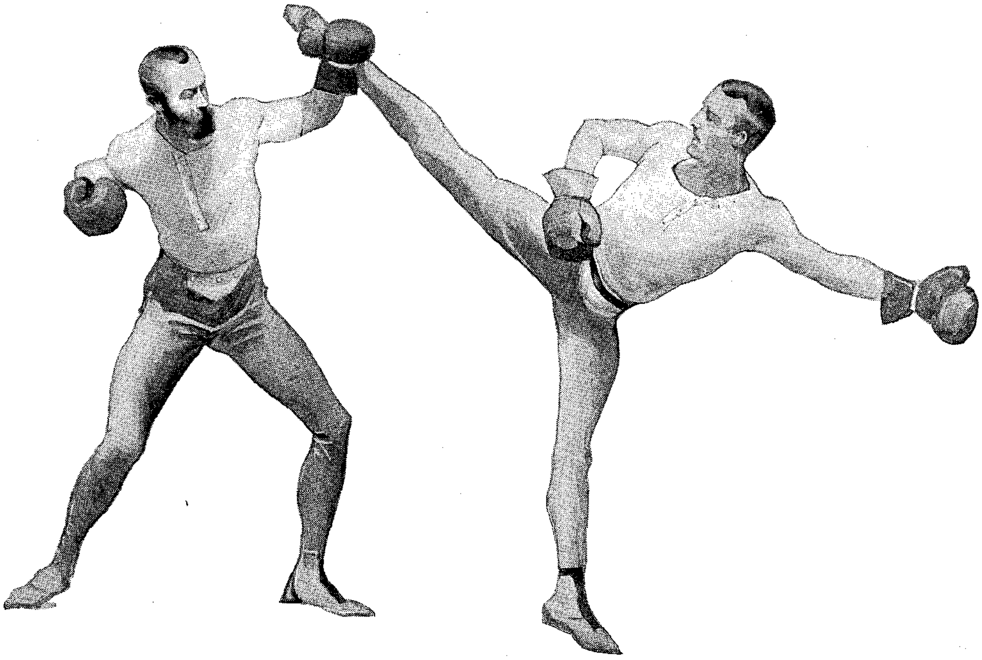
NO. 18.—BACKWARD FACE KICK, SHOWING PARRY.



NO. 19.—COUP DE SAVATE PARRIED, AND RETURNED WITH RIGHT-HAND BLOW (AFTER A PHOTOGRAPH).

It is a heel kick, and is delivered with a rush, thus having the momentum and weight of the body behind it. The three positions are shown in Nos. 7, 8, and 9. It is parried by drawing back the body, and bringing down the two hands on the foot (No. 10). The *coup de vache*, or cow kick, is another that has the momentum and weight of the body behind it. It is a sort of a hop and a kick, and is used when you rush at an opponent. The cow kick is given in two ways: first, by quickly replacing the front foot by the rear foot, and kicking out with the foremost foot, so that the heel strikes the enemy; second, *en croisant*, by bringing the rear foot across the other, and then kicking out.

The *coup fondamentaux* is an ornamental kick of little real use in actual fighting. This is the kick that plays around the head and face, that lightly taps the blushing cheek, and playfully



NO. 20.—FACE KICK PARRIED (AFTER A PHOTOGRAPH).

pats the top of the cranium. The two positions are shown in Nos. 11 and 12. Nos. 16 and 17 show the belt kick and the high body kick. No. 18 shows the backward side face kick and the parry; while No. 20 is a striking picture (as they all are) of front side face kick and parry.

The present representative professors of the savate in Paris are Messrs. O. Quillier; Charlemont, Jr.; and Leclerc, successor of Charles Lecour. The first is an amateur professor who teaches merely for the love of the art. To him I am deeply indebted for facilities given me for studying the savate. I also wish to return thanks to the Paris representative of the Eastman Kodak Company for courtesies extended.

FOODS IN THE YEAR 2000.

PROFESSOR BERTHELOT'S THEORY THAT CHEMISTRY WILL DISPLACE AGRICULTURE.

BY HENRY J. W. DAM.

"WHAT will the man of the future eat?" The answer to this question has been undertaken, not by an imaginative writer, but by one of the greatest of living men of science, Professor Berthelot of Paris; and it may be said at once that, but for his scientific eminence and the undeniable facts upon which he bases his forecast, it would pass the limits of human belief. The epicure of the future is to dine upon artificial meat, artificial flour, and artificial vegetables; drink artificial wines and liquors, and round off his repast with an artificial tobacco beside which the natural tobacco of the present will seem poor indeed.

WHEAT FIELDS AND CORN FIELDS TO DISAPPEAR.

Wheat fields and corn fields are to disappear from the face of the earth, because flour and meal will no longer be grown, but made. Herds of cattle, flocks of sheep, and droves of swine will cease to be bred, because beef and mutton and pork will be manufactured direct from their elements. Fruit and flowers will doubtless continue to be grown as cheap decorative luxuries, but no longer as necessities of food or ornament. There will be in the great air trains of the future no grain or cattle or coal cars, because the fundamental food elements will exist everywhere and require no transportation. Coal will no longer be dug, except perhaps with the object of transforming it into bread or meat. The engines of the great food factories will be driven, not by artificial combustion, but by the underlying heat of the globe.

In order to clearly conceive these impending changes, it must be remembered that milk, eggs, flour, meat, and, indeed, all edibles, consist almost entirely (the percentage of other elements is very small) of carbon, hydrogen, oxygen, and nitrogen. Oxygen and hydrogen are the two gases which, when combined, form water. Oxygen and nitrogen mixed are the air we breathe. Carbon forms the charcoal of wood, is the main constituent of coal, and as carbonic acid gas in the air is the chief food of the vegetable world. These four elements, universally existing, are destined to furnish all the food now grown by nature, through the rapid and steady advance of synthetic chemistry.

Synthetic chemistry is the special science which takes the elements of a given compound, and induces them to combine and form that compound. It is the reverse of analytic chemistry, which takes a given compound, and dissociates and isolates its elements.

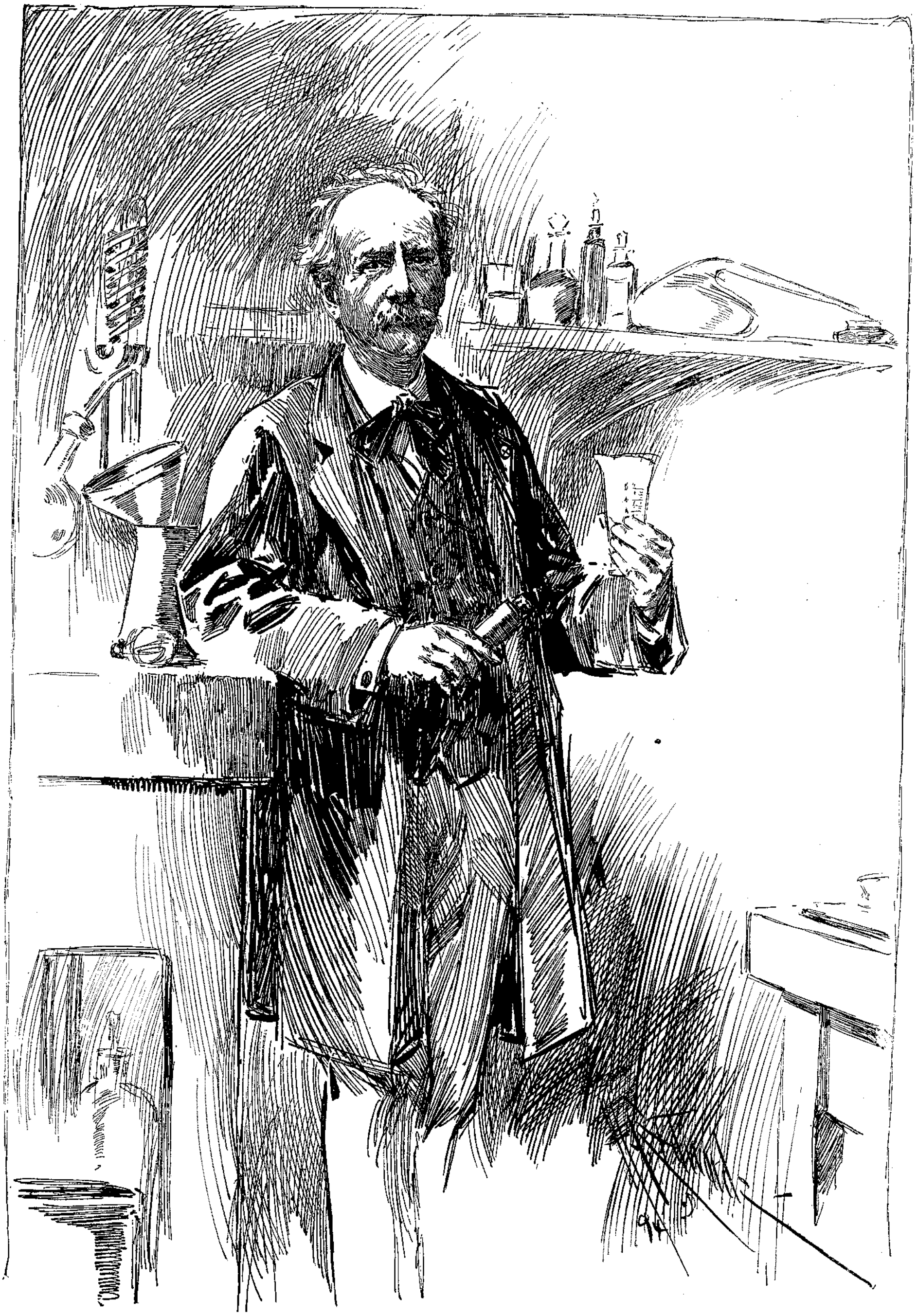
Analytic chemistry would separate water into oxygen and hydrogen, and synthetic chemistry would take oxygen and hydrogen, mix them, put a match to the mixture, and thus form water. For many years past synthetic chemistry has had an eager eye upon food-making. It has already progressed so far that several great agricultural industries have been destroyed by its advancement, compounds which were once obtained by plant growth in the fields being now entirely furnished by chemical laboratories and direct manufacture. In fact, the clear evidence of the present leads quite logically to the conclusion that at some more or less distant period in the future, synthetic chemistry will destroy all the great agricultural industries, and put to new uses the grain fields and cattle ranges of to-day.

PROFESSOR BERTHELOT.

No man is more entitled to act as a prophet in this field than Professor Berthelot. If not the father, he is certainly the foster-father, of synthetic chemistry as a special science, and for nearly fifty years he has been one of the leaders of the scientific army in the invasion of strange regions. In every way open to a grateful nation, France has loaded him with honors. He is a member and perpetual secretary of the Academy of Sciences, a member of the Institute, and a grand officer of the Legion of Honor. He is president of the Superior Council of Public Instruction, president of the Committee on Explosives, and in 1870 was president of the Committee on the Defence of Paris. As a cabinet minister he has had occasion and excellent opportunity to study the people, and as a life-long chemist he has enjoyed the best opportunities for considering the industrial changes which affect their condition. Many of the manufacturing improvements which have enriched France have been due, directly or indirectly, to his own chemical researches. Consequently, any predictions he ventures in his chosen field have the highest value, and I was particularly glad of an interview which he was good enough to accord me lately.

Professor Berthelot occupies in Paris a residential suite of apartments in the Institute of France. This is a great stretch of old brown stone buildings on the Quai Conti, with bare and barren courtyards paved with many square feet of gray stone blocks. The sense of coldness in the environment that you have after you have traversed two of these courtyards to the last doorway on the right, is dissipated by the cheery smile of a stout Breton sewing woman, who ushers you without delay through a long, dark corridor to a small, dark study at the end. Here, surrounded by books, which cover the walls on all four sides, sits at his desk the Professor. His slender figure, clad in professional black, is somewhat bent by the deep study which has made his fame, but otherwise his sixty-seven years sit lightly upon him. His greeting is grave, but entirely courteous and sympathetic, an intelligent curiosity concerning the field of research to which he has devoted his life being all that is required to arouse his interest and unlock his store of strange and interesting facts. The interview is had pursuant to an appointment, and he plunges at once into the subject, referring to his address of April 5th before the Society of Chemical and Mechanical Industries.

"That address," he says, "was in the nature of an after-dinner speech rather than a scientific pronouncement. We do not use the dryer language of science upon festive occasions. I was speaking, however, to an association of chemists, and I believe that all I predicted upon that occasion will, in the process of time, say the year 2000, be actually or approximately the existing state of affairs. I said that new sources of mechanical energy would largely replace the present use of coal, and that a great proportion of our staple foods, which we now obtain by natural growth, would be manufactured direct, through the advance of synthetic chemistry, from their constituent elements, carbon, hydrogen, oxygen, and nitrogen. I not only believe this, but I am unable to doubt it.



PROFESSOR BERTHELOT.

The tendency of our present progress is along an easily discerned line, and can lead to only one end."

"Do you mean to predict that all our milk, eggs, meat, and flour will in the future be made in factories?"

A TABLET OF FACTORY-MADE BEEFSTEAK.

"Why not, if it proves cheaper and better to make the same materials than to grow them? The first steps, and you know that it is always the first step that costs, have already been taken. It is many years, you must remember, since I first succeeded in making fat direct from its elements. I do not say that we shall give you artificial beefsteaks at once, nor do I say that we shall ever give you the beefsteak as we now obtain and cook it. We shall give you the same identical food, however, chemically, digestively, and nutritively speaking. Its form will differ, because it will probably be a tablet. But it will be a tablet of any color and shape that is desired, and will, I think, entirely satisfy the epicurean senses of the future; for you must remember that the beefsteak of to-day is not the most perfect of pictures either in color or composition."

This declaration from so high an authority was somewhat staggering. It was an unexpected blow at a tender (usually tender) and long-loved household idol. The common or garden beefsteak suddenly took upon itself a poetry and a pathos in the mind which could only have been born of its prospective superannuation. The idea of glass cows and brass beefsteak-machines, however scientific, carried a certain shock which was scarcely modified by the hope that the beefsteak of the future might, could, and would escape ever being tough.

"To comprehend what I mean by the tendency of the time," continued Professor Berthelot, "you must consider the long evolution which has characterized the development of foods and the major part which chemistry has played therein. The point is, that from the earliest time we have steadily increased our reliance upon chemistry in food production, and just as steadily diminished our reliance upon nature. Primitive man ate his food and vegetables raw. When he began to cook, when he first used fire, chemistry made its first intrusion upon the sphere of nature. To-day the fire in the open air has been replaced by the kitchen. Every cooking utensil now used represents some one of the chemical arts. Stoves, saucepans, and pottery are the results of chemical industries. So also modern cookery uses an indefinite number of compounds—food compounds—which, like sugar for instance, have been subjected to a more or less complex chemical treatment in their journey from the field in which they grew to the kitchen in which they are used. The ultimate result is clear. Chemistry has furnished the utensils, it has prepared the foods, and now it only remains for chemistry to make the foods themselves, which, indeed, it has already begun to do."

Before proceeding to describe what synthetic chemistry has already done in this direction, the Professor said, by way of preface:

"There is a distinction which I would like to make at this point between the laboratory stage and the commercial stage of any given discovery in food-making. From the scientific standpoint the laboratory result is the important one. As you and all the world know, the commercial result follows inevitably in time. Once science has declared that a desired end is attainable, the genius of invention fastens upon the problem, and the commercial production of the result slowly attains perfection by gradually improved processes at less and less cost. Take aluminium, for instance. Once a very expensive metal, its steadily decreased cost in production is bringing it within the reach of all. The use of sugar is universal. Sugars have recently been made in the laboratory. Commerce has now taken up the question, and I see that an invention has recently been patented by which sugar is to be made upon a commercial scale from two gases, at something like one cent per pound. As to whether or not the gentlemen who own the process can do what the inventor claims, it is neither my province nor my desire to express an opinion. It may be that the commercial synthetic manufacture of sugar is a more difficult task than they imagine. I have not the slightest doubt, however, that sugar will eventually be manufactured on the largest scale synthetically, and that the culture of the sugar-cane and the beet-root will be abandoned because they have ceased to pay. Look at alizarin. There is one result of the same kind that synthetic chemistry has already brought about."

"What is alizarin?"

A GREAT AGRICULTURAL INDUSTRY ALREADY DESTROYED BY THE CHEMIST.

"Alizarin is a compound whose synthetic manufacture by chemists has destroyed a great agricultural industry. It is the essential commercial principle of the madder root, which was once used in dyeing wherever dyeing was carried on. The madder root was grown to an enormous extent in Persia, India, and the Levant, and spread from there to Spain, Holland, and the Rhine provinces. Continental Europe used it in enormous quantities, and twenty years ago its annual import into England was valued at six million two hundred and fifty thousand dollars. The discovery was made, however, that alizarin could be manufactured synthetically, and the artificial production of it has so far supplanted the natural that the madder fields, so far as Europe is concerned, have practically ceased to exist. So with indigo. The chemists have now succeeded in making pure indigo direct from its elements, and it will soon be a commercial product. Then the indigo fields, like the madder fields, will be abandoned, industrial laboratories having usurped their place."

So far as dye stuffs were concerned, the intervention of chemistry seemed not so unnatural. When it came to tobacco and tea and coffee, however, synthetic chemistry appeared to be getting nearer home, invading the family circle, so to say.

"Tea and coffee could now be made artificially," continued the Professor, "if the necessity should arise, or if the commercial opportunity, through the necessary supplementary mechanical inventions, had been reached. The essential principle of both tea and coffee is the same compound. The difference of name between theine and caffeine has arisen from the sources from which they were obtained. They are chemically identical in constitution, and their essence has often been made synthetically. The scale of manufacture, or synthetic ladder, is as follows:

Carbon and oxygen make carbonic oxide.
Carbonic oxide and chlorine make carbonyl chloride.
Carbonyl chloride and ammonia make urea, whence uric acid.
Uric acid transforms into xanthine.
Xanthine yields theobromine.
Theobromine yields theine or caffeine.

Theobromine, you remember, is the essential principle of cocoa. Thus, you see, synthetic chemistry is getting ready to furnish, from its laboratories, the three great non-alcoholic beverages in general use. The tea plants, coffee shrubs, and cocoa trees must some day follow the lead of madder and indigo."

"And what about tobacco?"

EXCELLENT TOBACCO OUT OF COAL TAR.

"The essential principle of tobacco, as you know, is nicotine. We have obtained pure nicotine, whose chemical constitution is perfectly understood, by treating salomine, a natural glucoside, with hydrogen. Synthetic chemistry has not made nicotine directly as yet, but it has very nearly reached it, and the laboratory manufacture of nicotine may fairly be expected at any time. Conine, the poisonous principle of hemlock, has been made synthetically, and it is so close in its constitution to nicotine, and so clearly of the same class, that only its transformation into nicotine remains to be mastered, a problem which is not very difficult when compared with others which have been solved. The parent compound from which the nicotine of commerce will be made, exists largely in coal tar."

"You believe, then, that all our tobaccos will some day be made artificially?"

"To as great an extent as appears desirable. The choicer growths, with their individual characteristics from individual circumstances of growth, will be longest cultivated. The tobacco leaf is simply so much dried vegetable matter, in which nicotine is naturally stored. Chemistry will first make the nicotine, and impregnate any desirable leaf with it to any degree of strength. Later on, if necessary, it will also make the leaf. In some directions it is not difficult to improve upon nature, and the best chemical medium for carrying nicotine might easily prove superior to the natural."

Having weakly permitted his beefsteak to be carried by storm, the writer was all the more inclined to defend his tobacco. "But, surely," said he, "there is something more in fine tobacco than merely nicotine and vegetable fibre."

"Precisely. Leaving aside what the manufacturers may add, there are delicate flavoring oils, which chemistry will also create. Vanilla, a flavoring compound of very general use, has always been obtained, until recently, from the tonka bean. Now artificial vanillin, in the same compound made chemically, threatens to drive the natural vanilla out of the European market, and will doubtless succeed in doing so as its manufacture is perfected. In fact, some of the chocolate and confectionery manufacturers are already taking it up. All the essential oils will eventually be made direct. Vanillin is very near in its chemical constitution to the aromatic, the distinctive, principle of cloves and allspice. Artificial cloves and allspice will therefore probably come next. Flower perfumes, too, have been fully analyzed, and in time will be largely synthesized. One of them, meadow-sweet, is being largely compounded and sold. There are consequently no virtues in the natural tobacco which are likely to be missed in the artificial. In fact, the contrary state of affairs is more probable."

With our tobacco prospectively obtained from coal tar, and our flower perfumes made without flowers, the sphere of synthesis was decidedly broadening. Professor Berthelot, however, made it broader, touching upon an important law of which he himself was the discoverer.

USEFUL COMPOUNDS UNKNOWN TO NATURE IN PROSPECT.

"Perhaps the greatest importance, and certainly the profoundest charm, in the study of synthetic chemistry," said he, "is the certain evidence which it offers of the discovery and manufacture of many compounds now entirely unknown, whose effect upon human health, human life, and human happiness no one can possibly conjecture. A hundred years ago, for instance, who could have foretold photography or the telephone? To understand the prospect before us, you must recall the familiar laws of atomic proportion which characterize the combination of different elements in mineral chemistry. Among the metals of a given class, the combinations with oxygen, for example, follow the same atomic law, and, by means of this law, compounds which had not been met with by chemists were from time to time looked for and created. In other words, the acting law of atomic proportions having been discovered, the chemist knew what to expect in a given class of metals, and wrote the formula, in many cases, before he obtained the compound.

"Now, in mineral chemistry the operations of this law are limited. In organic chemistry they are limitless. When I found that the same general laws acted uniformly throughout the measureless field of organic chemistry, I saw that the number of compounds to be dealt with in this way was numberless, infinite in extent. How many compounds each having, like nicotine or theine, its own distinctive peculiarities, remain to be discovered, it is simply beyond our power to imagine. Analytical chemistry has dealt and could deal only with what it found in nature. Synthetic chemistry, armed with the elements and with the knowledge of the laws by which classes of complex compounds combine with other classes of complex compounds, will go on and on, developing new fixed compounds not yet met with in nature, whose influence upon human life, as I have said, no mind can possibly foretell. The science of chemistry grew out of the search for two things, the elixir of life and the philosopher's stone. These two will never be discovered; but, that other compounds almost as wonderful in their way may be, it would be dogmatic and rash to deny. It is a great, untraversed country, a field of exploration for chemical students for centuries to come."

In illustration of this point, as well of his own methods of study, he continued:

"I passed hydrogen over carbon at a white heat, and by aid of the electric spark obtained a combination, the result being a familiar gas, acetylene.

"I found that acetylene would take up another atom of hydrogen in the nascent state, and this gave me marsh gas and ethylene.

"I found that ethylene in the presence of water could be made to combine with the oxygen and hydrogen of the latter, thereby forming ordinary alcohol, and that marsh gas in the same way formed methylic alcohol.

"Combining the acetylene with free oxygen in the nascent state, I obtained oxalic acid.

"Combining the acetylene with free nitrogen by aid of the electric spark, I obtained cyanhydric acid.

"Combining the acetylene with oxygen in the presence of water and an alkali, I obtained acetic acid.

"I also found that under certain conditions the acetylene could be transformed directly into benzine. Here, then, we have seven familiar compounds of wide utility, acetylene, marsh gas, alcohol, oxalic acid, acetic acid, cyanhydric acid, and benzine, to say nothing of many others which I might mention, obtained from these elements direct. Now, imagine for a moment the enormous number of organic compounds into the constitution of which, according to regularly acting laws, these seven compounds enter. There are six different families of alcohols alone, and each one of these families embraces a greater or less number of special alcohols. Here is a great list of alcohols, each one representing in combination an indefinite class of alkaloids. Some of these alkaloids are known, many more can be conjectured, and what may not develop from them when they are studied and tested in their relation to life and the arts? Over the whole field of organic chemistry the mystery of possibilities extends. Its combinations and intercombinations are so limitless that we can only work on regularly to ends that it is impossible to foresee. A discovery may arise at any time which will have an incalculable effect upon the happiness and welfare of man."

"What do you think of Tyndall's dogma, that from the non-living the living can never be obtained?"

"We do not know enough about the question to dogmatize," said Professor Berthelot, simply. "We shall see what we shall see."

Outside of the products named, the proved results of synthetic chemistry appeared to be already numerous. The oil of bitter almonds is now being made direct commercially, and so also is the oil of mustard. Mustard made from the oil of mustard is preferred for use as an irritant by many physicians, in consequence of its purity, which is perfect; whereas the natural mustard contains other compounds not entirely desirable in this connection. Salicylic acid, tartaric acid, the acid of unripe grapes, and citric acid, the sour principle of lemons and other fruits, are made direct. Artificial turpentine is being actively sought after, and from it chemists expect to obtain artificial caoutchouc. Long before the promised failure of the rubber trees to supply the demands of commerce, synthetic rubber will, in all probability, have filled the void. From a review of what synthetic chemistry has already done, the Professor passed to the subject of what it may reasonably be expected to do. He said:

ASS'S MILK, GOAT'S MILK, AND COW'S MILK ALL FROM ONE LABORATORY.

"The production of food stuffs upon a commercial scale by synthetic chemistry will naturally depend upon two things: the cheapness of production, and the quality of the result. Take artificial butter as an instance. Twenty years ago in this country the idea was conceived of making butter from beef fat. This was an intermediate synthesis, which consisted in extracting the oleo-palmitine from the fat by melting, cooling, and pressure. The extract was then treated with milk, churned, and colored as the dairymen colored natural butter. The growth of the oleomargarine industry has been extensive, and its manufacture now takes place on a large scale. The best artificial butter approaches so closely to real butter that the difference is not very great. In the same way, whenever synthetic chemistry is ready and the commercial conditions have been met, artificial chemical food will infringe upon the sphere of the natural in other directions. Nature, however, produces very cheaply; and no man will desire to lose money for the pleasure of making chemical food. There is no reason, nevertheless, since we are making artificial butter, why we should not before long make artificial milk. Milk consists of say 3.50 per cent. of milk fats—olein, stearine, butyrine, palmitine, and others—3.98 per cent. of caseine, four per cent. of milk-sugar, and 86.87 per cent. of water, with traces of other substances which have been determined. It will not be a very difficult problem for synthetic chemistry to mingle these constituents in these proportions, and make a milk that will as nearly approach natural milk, in meeting the demands and desires of the public, as artificial butter approaches natural butter. So, too, the variation of proportions would be easy; and ass's milk, goat's milk, or any other milk desired, could be furnished from the same laboratory as easily as cow's milk. The only necessity is, that we shall be able to make all the solid constituents mentioned, and this is simply a matter of time. In short, milk factories may be looked for just as soon as the constituents can be directly and cheaply obtained."

"But will such milk be as healthful as that produced naturally?"

"There is no reason why it should not be. With the vital action and vital machinery by which the cow produces the milk, chemistry has nothing to do. It is a question of physiology. When the milk has left the cow, however, it is merely a chemical compound, and with it physiology has nothing to do. As I said, the fats I have already made direct. The milk-sugar, too, has been made. When we come to the caseine, however, and, with it, to starch, meat, and albumen, we come into a set of very complex chemical problems. Still, they are merely chemical problems, and as such are subject to study and solution in the future, just as we have seen equally difficult problems met and solved in the past. The mass of animal tissues are constituted of certain nitrogenous compounds which play an equally important rôle in the development of vegetable tissues. These compounds are very complex, nearly always fixed and uncrystallizable, and easily affected by re-agents. Some are soluble and some insoluble, but most of the former become insoluble by coagulation in water, through heat or through the action of acids. Such are albumen, fibrine, caseine, syntonine, osseine, chondrine, glutine, chitine, etc. To make meat we must make these compounds, or so many of them as are necessary. That chemistry will some day be able to make them I cannot doubt. That at some time in the future artificial meat will infringe upon the domain of natural meat, as artificial butter has upon that of natural butter, is only to be reasonably expected. So with the vegetables. A potato consists of, say, 81.844 per cent. of starch, 13.030 per cent. of water, 2.313 per cent. of nitrogenous matter, 1.13 per cent. of woody fibre, and minute proportions of fat and mineral constituents. When we are able to make starch direct, what will hinder us from making a potato? And what is to prevent us, once we have gained the mastery, from making better milk, better meat, and better potatoes, at any season of the year, than those which nature gives us, more or less afflicted, as these are, with impurities and additions, and produced only at the periods in which her laboratories are kept open for the public good?

STEAM TO BE PIPED FROM THE CENTRE OF THE EARTH.

"Time is not an element in these speculations, because all the future is before us, and the line of march is marked out. Great changes, however, which will cheapen the cost of producing these results, will come from cheaper and simpler sources of mechanical energy than those now used. Herein lies the fundamental problem of all the industries, to discover sources of energy which are inexhaustible and which will renew themselves without effort on our part. Nature has given us these, ready for our use, but as yet we have accepted only a very small portion of her gift. Evolution has long acted in this direction also, and must continue to act. We have seen the force of human hands largely replaced by that of steam, that is to say, by chemical energy borrowed from the combustion of coal. Coal, however, is laboriously extracted from the bowels of the earth. The time is coming when, by methods already foreseen and unnecessary to describe, we shall store and make use of the heat of the sun. But greater, far greater in importance than this, will be the ultimate and widespread use of the central heat of our globe. The incessant advances of science give us a sure basis upon which to expect a limitless amount of energy drawn from this source. It will suffice, to utilize the central heat, to sink pits from three thousand to four thousand metres (three thousand three hundred to four thousand four hundred yards) in depth, and this is a problem in engineering quite within the powers of the engineers of the present day, to say nothing of the engineers of the future. At this depth we should find great heat, constant and unvarying, the heat which is the source of all energy and all life."

The writer could personally vouch for this. He recalled having his back scalded by dripping water in one of the three thousand two hundred foot levels of the Comstock Lode.

"At these depths," said Professor Berthelot, "we may easily tap superheated steam under pressure which can be used to drive machinery direct from the top of the shaft. That, however, is merely a detail. We shall have in these pits the cheapest of furnaces, because we can have them at any degree of heat, never failing and never needing fuel or renewal. They will be at some distance from our engines, to be sure, but that will be no difficulty. Into them we can introduce water, if necessary, convert it into superheated steam at the bottom, and use it on the surface. More than this, the advance of thermo-electric science is certain, once the inventions are needed, to supply us with another and perhaps more convenient means of turning this heat into force and using it for mechanical purposes at a cost, after the plant is constructed, which will be no more than the wear and tear. We shall thus have a source of energy which costs nothing, whose extent is indefinite, which is incessantly renewed, and whose diminution through centuries will be quite imperceptible. And this will be force which will be available everywhere, all over the globe, and equally the blessing, with the property which results from it, of all nations and all peoples which seek its use. Given such sources of energy, the artificial production of food will be a much simpler problem, and will more rapidly fall into the hands of chemistry. The hard preliminary work is done. The synthesis of the fats and oils I myself accomplished years ago. That of the sugars and carbo-hydrates is the study of the present time, and that of the nitrogenous compounds is not far off. Carbon from carbonic acid, oxygen and hydrogen from water, and nitrogen from the air will be a source of food for all the world. What the animals and vegetables have produced through the energy of nature, we shall produce as well, if not better, by our study of nature's laws. Strange though it may seem, the day will come when man will sit down to dine from his toothsome tablet of nitrogenous matter, his portions of savory fat, his balls of starchy compounds, his casterful of aromatic spices, and his bottles of wine or spirits which have all been economically manufactured in his own factories, independent of irregular seasons, unaffected by frost, and free from the microbes with which over-generous nature sometimes modifies the value of her gifts."

"And all this will be due to chemistry?"

A SYNTHETIC ARCADIA.

"To chemistry and her sister science, physics. If one chooses to base dreams, prophetic fancies, upon the facts of the present, one may dream of alterations in the present conditions of human life so great as to be beyond our contemporary conception. One can foresee the disappearance of the beasts from our fields, because horses will no longer be used for traction or cattle for food. The countless acres now given over to growing grain and producing vines will be agricultural antiquities, which will have passed out of the memory of men. The equal distribution of natural food materials will have done away with protectionism, with custom-houses, with national frontiers kept wet with human blood. Men will have grown too wise for war, and war's necessity will have ceased to be. The air will be filled with aërial motors flying by forces borrowed from chemistry. Distances will diminish, and the distinction between fertile and non-fertile regions, from the causes named, will largely have passed away. It may even transpire that deserts now uninhabited may be made to blossom, and be sought after as great seats of population in preference to the alluvial plains and rich valleys, soils fat with putrefaction, which constitute the great agricultural and popular centres of to-day."

"And man?"

"Man should grow in sweetness and nobility, because he will have done with war, with existence based upon the slaughter of beasts. Perhaps—this is only a dream, remember—synthetic chemistry, or something that we might call spiritual chemistry, will develop means to as profoundly alter man's moral nature as material chemistry will change the conditions of his environment. There is no fear that art, beauty, and the charm of human existence are destined to disappear. If the surface of the earth ceases to be divided, and I may say disfigured, by the geometrical devices of agriculture, it will regain its natural verdure of woods and flowers. Man, becoming familiar with the principles and responsibilities of self-government, will be more easily governed. The favored portions of the earth will become vast gardens, in which the human race will dwell amid a peace, a luxury, and an abundance recalling the Golden Age of legendary lore.

"These are dreams, of course," added the Professor in conclusion, "but science may surely be permitted to dream sometimes. If it were not for our dreams, where would be our impulse to progress?"

WITH MADNESS IN HIS METHOD.

By Florence L. Guertin.

COURTRIGHT went quickly up the steps, looking at his watch, and touched the bell. Her brougham was standing in front of the door, and he knew that she would be ready.

She came down-stairs in a plain, dark travelling gown, with the violets he had sent her pinned to her top-coat, and with a maid, bearing her satchel and umbrella, behind her.

"To the Forty-second Street Station," he said to the man on the box, and the sleek-looking cobs sprang forward.

It was about a year since Courtright had first met Miss Schuyler. The acquaintance had begun on board a train bound for California, and they had become very good friends. The following winter found him a steady caller at the Schuyler domicile, yet in no way receiving preference above the other men who called quite as frequently, and who were also more or less enamoured of Miss Schuyler's healthy type of loveliness. At least, if he was preferred, it was not made known, and he was treated with the same cordial frankness that characterized her manner toward all. Some one had once sagaciously remarked that Constance Schuyler could not be a flirt, for she was too much interested in every man she met; and perhaps the secret of her popularity lay in the fact that she was interested in people, which always flatters, and generally awakens interest in return. Courtright said she possessed adaptability in a very marked degree, and that it was that quality which enabled her to make friends with the oldest and crustiest of bachelors, or with the youngest and most swaggering of college youths; and that with all her vivacity and high spirits there was an undercurrent of sympathetic womanliness that appealed to you; and he summed it up by saying that she was the most delightfully human and thoroughly lovable girl he had ever met.

In the absence from town of her father he had said that he wanted the privilege of escorting her to the station, and as they bowled along in the snug little brougham he told her that there was something else he wanted, and then repeated the sweet, ancient story in a manly, nineteenth-century fashion.

It was no novel recital to Constance Schuyler, yet she wondered why it had never before been so hard to say "No." But she said it very firmly and decidedly, for if she loved him now she had not found it out, and it was much better to tell him how sure she was, rather than to let him go on, deluding himself with the vain idea that some time she might grow fond of him. After her frank words, Courtright, looking out of the window, replied, meditatively:

"No, I should not want to hang around a woman for years, hoping that some day she might care for me, and bothering her about it. I should want her to come to me gladly, and because she wanted to, and I would not marry Venus herself unless she loved me." Then he looked at her critically, and continued, with delightful audacity: "I think I could marry you, though, if I did persevere, but I should always feel that perhaps you were not giving me your best love. It seems to me that that sort of thing ought to be spontaneous. I shouldn't care to be married to be gotten rid of."

"But you believe that love is a gradual growth, don't you?" Constance asked, wishing in spite of herself to explore further into this partly known, but still fascinating territory.

"Not necessarily," he answered.

Note.—"With Madness in His Method" was awarded the fourth prize in the recent McClure prize-story contest. The author, Miss Florence L. Guertin, lives in Brooklyn, New York. The story entitled "The Mistress of the Foundry," published in the August number of McClure's, it should have been stated there, was awarded the fifth prize in the same contest. The author of it, Earl Joslyn, lives in Pasadena, California.—Ed. McClure's Magazine.

"Do you remember the morning that I first saw you, going out to California? The train had stopped, and Peters and I got out to walk up and down the station. You came out of the car and stood on the platform, talking to some one below the steps. I heard you laugh, and looked up, and saw you standing there with your head a little thrown back, and your white teeth and dimples showing. I think I succumbed on the spot. I couldn't get you out of my thoughts, any way, and didn't rest until I had met you. It entailed two days of conversation on the general state of the country with your father, in the smoking-car, and the consuming of no end of cigars, but I was rewarded at last."

Miss Schuyler laughed.

"And all the time poor father never suspected the deep scheme you were laying, and gave you no end of credit for being clever, because you listened to his views on the silver question and the tariff, and everything else he was interested in. He used to come back from the smoking-car to mother and me, and tell us about the bright chap with whom he had been 'settling the affairs of the nation.'"

She congratulated herself that she had steered the conversation off dangerous ground and that it had taken a less serious turn. Personalities, above all, she felt were to be avoided. But Courtright evidently did not agree with her, and plunged boldly in again.

"I saw something in your face that day, as you stood there, that I had never seen in any woman's before. I don't believe I could explain it to you,"—as she looked at him inquiringly,—"but"—coming down to what he could explain—"you know you're an awfully fetching girl, Miss Schuyler, and I think, even if I were married to you, I'd always be a little jealous. I used to want to make jelly of that young Whitney who tried to monopolize you in Pasadena. You're the sort of girl"—continuing to analyze her as if she were not present—"that will always attract men, without effort. I suppose it's magnetism, and besides"—turning and looking straight at her—"you're so peachy, and so—so—ridiculously kissable,"—ending with a half-apologetic laugh.

Constance Schuyler grew "peachier" and felt that she ought to frown, yet was conscious of a little exultant feeling within her, almost as if she were glad Courtright thought all those absurd things about her. But she said aloud, she was very sorry he felt as he did, and that as long as he continued in the same frame of mind he must not come to see her, as it would hardly be fair for him, when she felt so very certain about herself. Then the carriage drew up in front of the big red station, and there was not time to answer this rather depressing remark. They passed through the crowded waiting-room out into the vast skeleton-like building beyond, and proceeded to "walk a mile" to the train.

Courtright thought of her last remark and made up his mind he would never adhere to it. He felt very downcast as he realized that he was giving her up, for a time at least, and that she was going to a place where, of course, every man there would want to marry her. He glanced down sidewise at her, thinking how sweet she was, and found that she too did not look particularly cheerful.

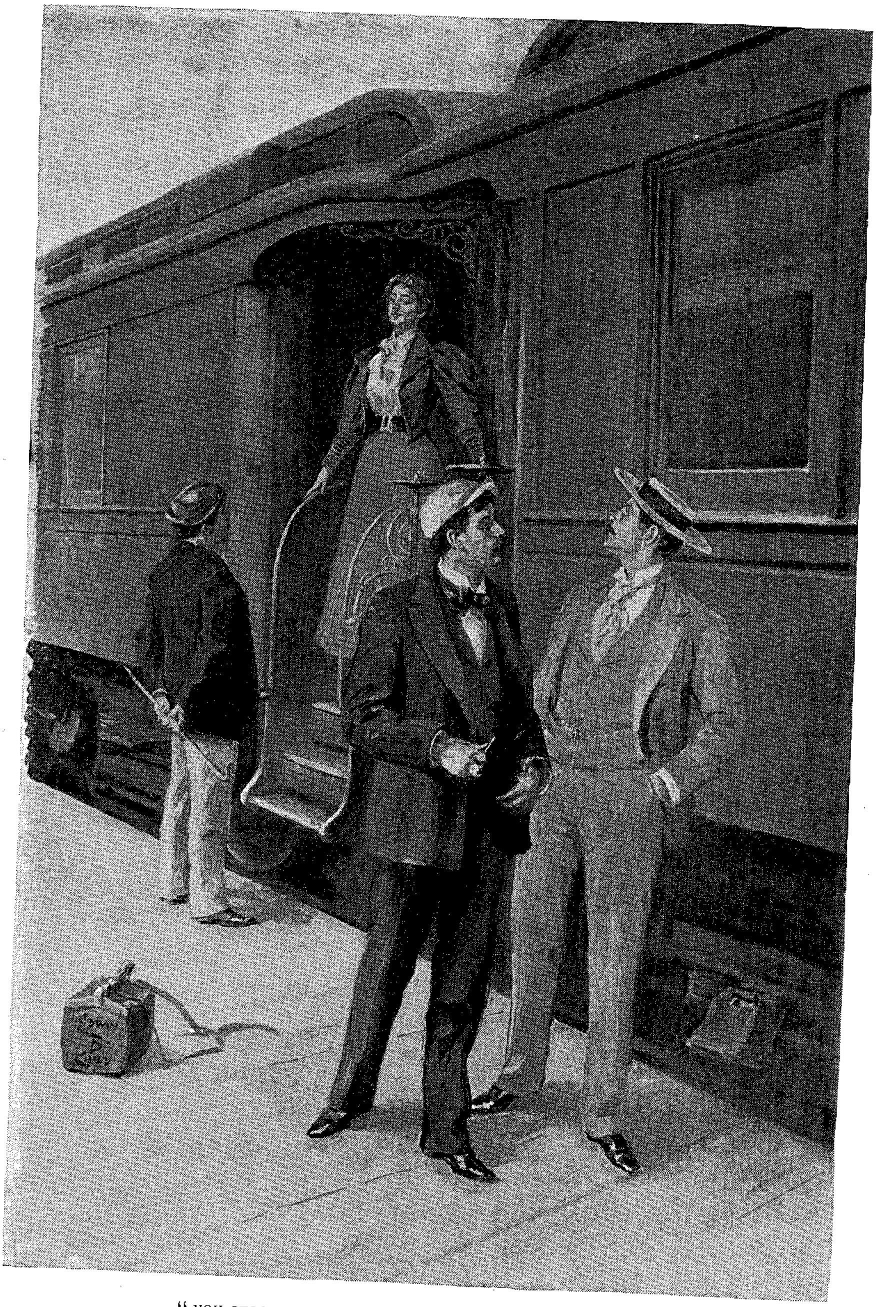
"Constance," he said quite low, "if this is the end, won't you let me kiss you good-by—just once?"

Miss Schuyler almost stood still with astonishment and grew at least three inches taller.

"Certainly *not*," she replied, in the most emphatic tones of which she was capable, looking at him so severely and with such utter consternation on her face that Courtright had to bite his lip and pull hard at his mustache to keep from smiling. She saw that he wanted to laugh, and felt that she had not succeeded in properly snubbing him. She went on indignantly, taking the first argument that came into her mind, and in which her conventional training and desire for appearances asserted itself:

"What a frantic idea! What would the people on the train think of you?"

"Oh, they wouldn't think anything of it," he said; and added drolly, "I'd say 'Give my love to Maria' or some-



"YOU STOOD ON THE PLATFORM, TALKING TO SOME ONE."

thing like that, and then simply kiss you."

It sounded so absurd that Constance laughed, in spite of herself, but had no fear. In her eyes it would have been a heinous crime, and Courtright, she knew, was a man to be trusted. Then the train made a feint of starting, and they ran a little for fear of losing it. There was but one chair vacant in the centre of the car, holding out its arms to receive her, when they entered, and she dropped into it, panting a little.

"Good-by," she said, looking up at him, and holding out a neat tan-gloved hand. "Good-by," he answered, taking it in his own and holding it a second longer than was necessary; and then, before she knew what he was about, he stooped, and saying, "Give my love to Maria!" lightly kissed her cheek.

It was only a very little kiss, and landed almost on her ear, just above the high fur collar of her coat, and was taken through one of the little dotted veils she generally wore, but it was enough to send the hot blood surging to her eyebrows, and to awaken indignation and rebellion within her.

He saw instantly the mistake he had made, and regretted bitterly the spirit of mischief that had prompted him to the act. She was leaving him in anger, and there was not time to prevent it. The train was puffing and catching its breath, as if to collect enough to propel it, and was already slowly moving. He glanced down at her pleadingly.

"You will send me your card, when you return?" he said.

"Never," she replied shortly, returning his glance with a look that contained fire and swords and other deadly weapons, and almost petrified him on the spot. He was obliged to leave the car or go with it, and he did the former, half dazed, realizing, as he stood on the platform watching the receding train, that he had gone a step too far. Of course she was hurt and insulted, and he called himself a cad, and other hard names, and said no penance would be too great for him. Then an idea came to his troubled brain, and, turning, he walked quickly back to put it into execution.

For one hour Miss Schuyler remained motionless in her chair, too stunned to move. That Courtright, of all men, should offer her such an affront, had almost taken her breath away. It not only outraged her inbred ideas of propriety, but destroyed every particle of her faith in men, and she told herself she could "never forgive him." She was still wearing her heavy coat in the warm car till she felt of her forehead and found that it was feverish, and that she herself was almost stifling. Slipping off the coat she hung it up, laying his violets scornfully on the window-sill. She would not wear them. Then she resumed her former position, with her head on the back of the chair, repeating to herself, "How could he do it? How could he do it?"

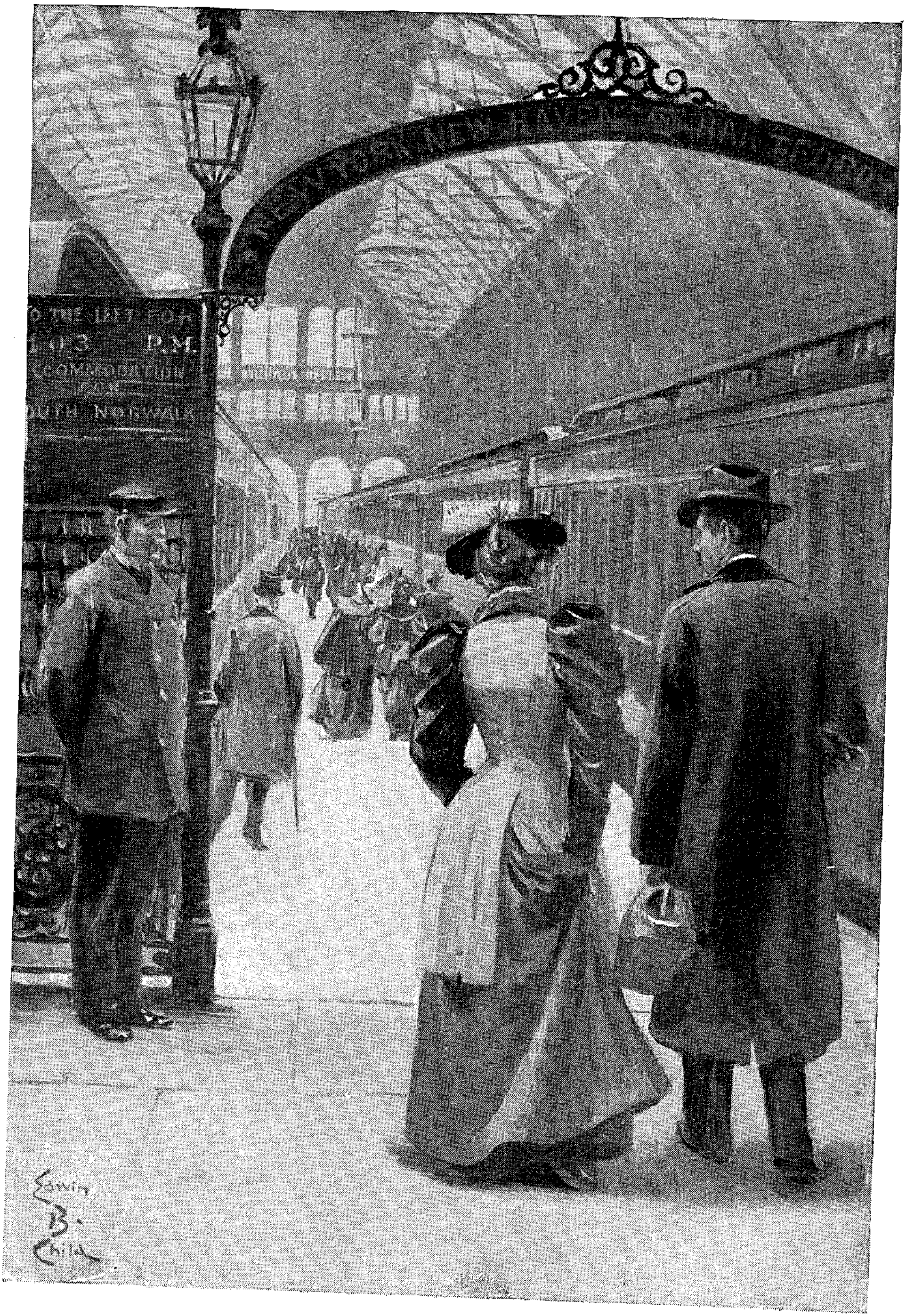
The train was pulling into Stamford when a very small messenger boy boarded the car, calling, in a voice that was a credit to his size:

"Is Miss Schuyler here?"

Constance sprang to her feet. Her first thought was of home. Had her mother been taken suddenly ill, and had they sent for her? Or had her father met with one of those horrible accidents with which the papers abounded? A thousand awful possibilities flashed like meteors through her mind, as with trembling fingers she tore the envelope open.

"Regret exceedingly my conduct on train.—Courtright," were the words that met her frightened eyes. In the reaction that came she felt almost grateful to Courtright for having something for which to apologize. Then the impropriety and rudeness of it rushed back, and she hardened her heart against listening to his repentance. Of course he regretted it, she would give him credit for that, but the act had been altogether unpardonable. She repeated this to herself a great many times for fear she might forget it.

The train was now at Bridgeport, but she was hardly conscious that they were stopping until her reveries were suddenly broken by again hearing her name. A second blue-coated envoy stood at one end of the car, bawling, like the first, for "Miss Constance


NEW YORK NEW HAVEN & HARTFORD
O THE LEFT FOR
103 P.M.
CCOMMODATION
FOR
OUTH NORWALK
Edwin B. Child

THEY PASSED OUT INTO THE VAST SKELETON-LIKE BUILDING.

Schuyler!" With flaming cheeks she half rose and announced that she answered to that title, feeling that the eyes of every one in the car were fastened upon her, and wishing that Courtright was out of existence. What did he mean? she asked angrily. Had he not made her conspicuous enough for one day? What would these people say of her, to board a train with a man who had kissed her good-by and sent her telegrams at every station? And what was old Mr. De Peyster, who sat near her and was a political friend of her father's, thinking of her, as he lowered his paper and peered over his glasses at her, watching her open the yellow envelope? She glanced at it leisurely, knowing now that there was no cause for great alarm.

"I realize that it was rude and ungentlemanly.—C." she read.

Constance's lip curled with disdain as she thought that she too realized it, and she took a novel from her bag and tried to lose herself in it. But her mind, in its present volcanic state, refused to follow the placid path of the heroine, and would not concentrate itself. She kept her eyes on the open pages, preferring not to meet the inquisitive glances of those near her. She had never felt so uncomfortable, and blamed Courtright more than ever. The very car wheels were singing a monotonous song of which the refrain was: "Give my love to Maria—Give my love—to Maria," at any other time appealing to her sense of humor, but now only fanning her ire. But it was to rise yet higher, for at New Haven a third messenger entered and followed the example of his strong-lunged predecessors. It was the first time she had ever wished to disown the proud name of Schuyler, and she felt a further strong inclination to throw the telegram unopened out of the window. It proved to be a continuation of the other two, reading:

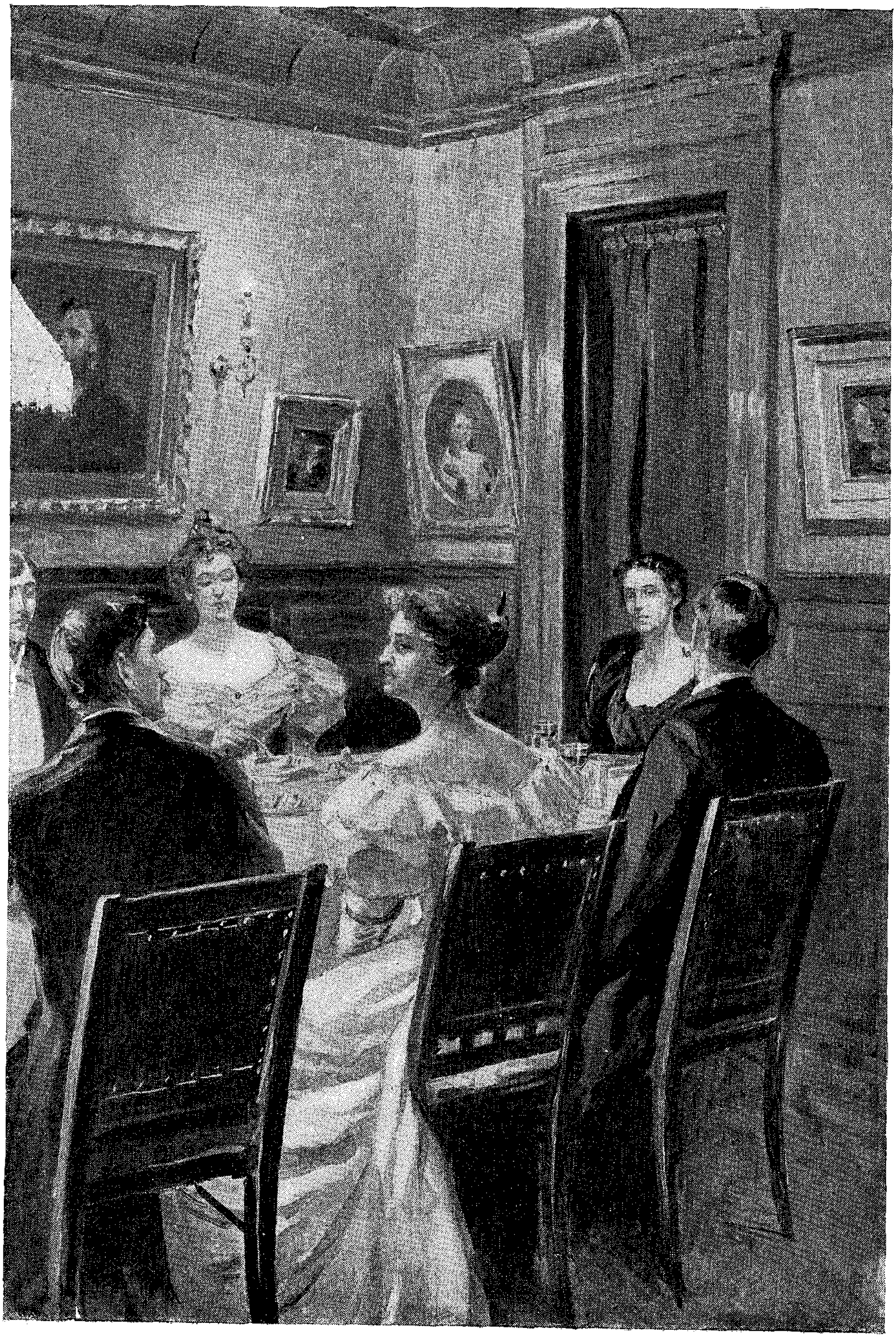
"And sincerely beg your pardon. Please answer.—Courtright."

But she told the boy that there was no answer, and, signing the book, watched him depart, as he wondered what made the young lady's cheeks so red. There was no mistaking the fact that now she was an object of much more interest to the occupants of the car than the books and magazines they held. With one accord her travelling companions glanced curiously at her, and the young man with the checked clothes, who had stolen furtive glances before, now stared at her quite boldly, making her cheeks burn as if all the blood in her body had settled there. She thought her anger at Courtright had long since reached the boiling point, but it now bubbled over and effervesced. How dared he humiliate her so? She would give anything to escape those awful looks. Even the porter and the conductor were eying her suspiciously, conversing with heads together at one end of the car, she felt sure, about her. And when the latter moved towards her and stopped at her chair, she almost thought he had come to request her to leave; and so he had, but merely to the car in front, as she had taken a seat in the wrong one. She welcomed gladly any escape, and he helped to move her things. She glanced at the violets on the window-sill, hesitating about taking them. It was too bad to leave them there to fade, she told herself, and snatching them up hastily she followed the conductor.

She breathed a long sigh of relief when she was reëstablished in the preceding car, with her back to the "fresh" youth and his inquisitive neighbors.

When the train reached Hartford, Constance watched the door with anxious eyes, fearing to be confronted by a fourth telegraphic emissary, but was spared any further ordeal. The time from now on dragged wearily, and was spent in ringing the changes on the proceedings of the morning, and in bitter arraignment of Courtright for daring to kiss her, and for his inconsiderateness in sending her the telegrams. As she stepped off the train in Boston she felt that it had been the most uncomfortable journey she had ever taken, and that her visit in Boston was not commencing under the most auspicious of circumstances.

But after a busy week of rushing from one thing to another—recitals, lectures, teas, and symphonies, morn-



SHE TURNED TO THE MAN ON HER LEFT, WHO WAS NEW MATERIAL.

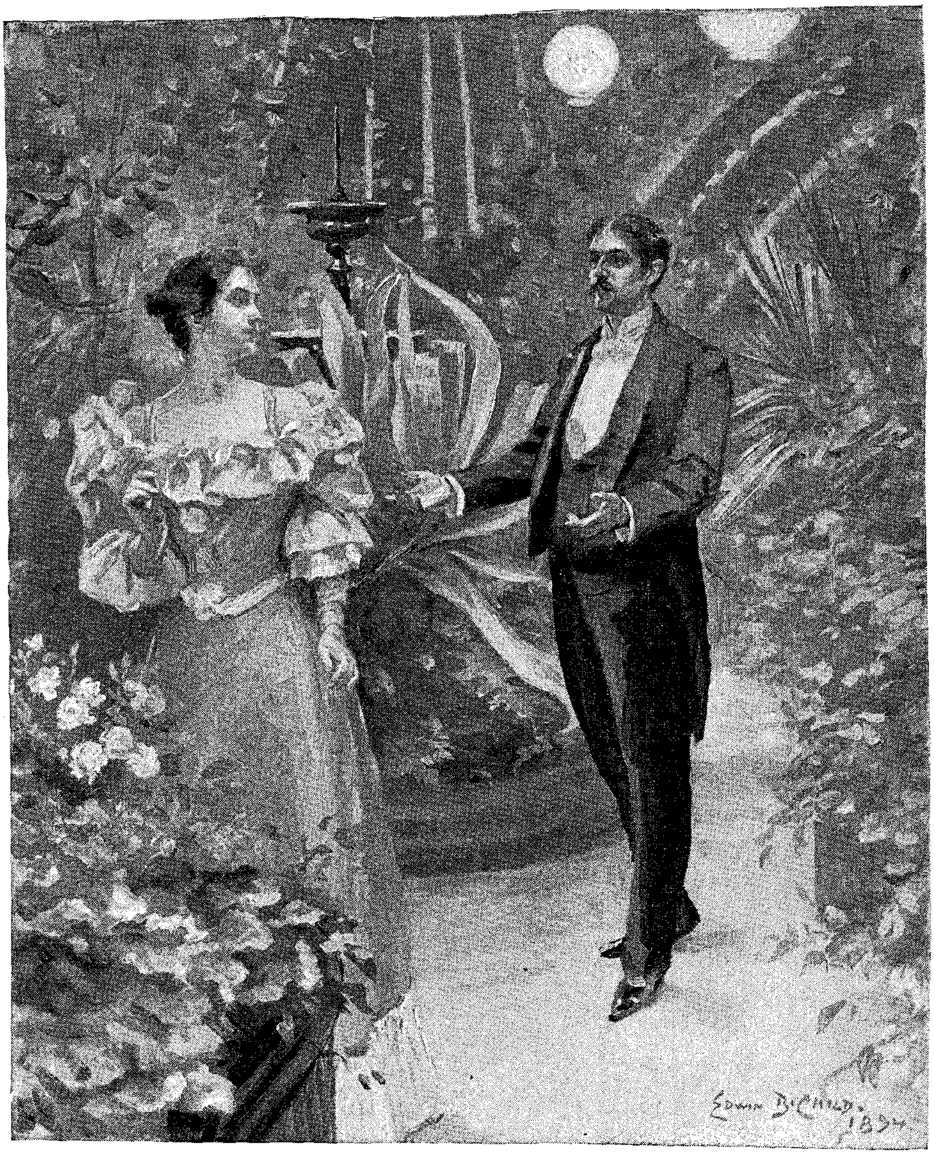
ings with Browning and afternoons with Ibsen, Mental Science, Darwinian, and other clubs, with now and then a frivolous dance thrown in—she found to her surprise that Courtright still remained uppermost in her thoughts. Though his conduct yet awoke indignation, she was able to review it more calmly, and at length caught herself drawing comparisons between him and the men she now met, with the credit in his favor. She realized that he was a man of daring—one who would make his mark in the world by bold strokes—and was surprised to find how closely associated he was as well with the little things of her life. Her very umbrella suggested him, as she recalled the morning they had chanced to meet on Broadway, when Courtright was uptown buying a wedding present for some one, and had turned to walk with her. They were caught in the rain that soon fell, and he had rushed her into Gorham's for shelter, and had insisted on her choosing a pretty umbrella from the "affluence of selection" offered them, and she recalled how they had gone home together under it, in preference to taking a cab. It had been such fun, and she sighed to think that it was all over. Then she went back to that last morning, and found that out of the chaos of resentment that had then wrought such tumult in her soul one thing only now seemed to stand out clearly—Courtright loved her, and she had refused him, putting an end to all companionship whatever. She thought of the time when she would return home and would not see him, except to meet him occasionally at the big affairs to which they would both be invited. She thought of the walks and drives and box parties, that would continue, but at which he would be missing, and was surprised to find how unattractive they appeared. Other men would be ready to step into the breach, but could they fill his place, she asked herself? Whom did she know as bright and amusing as he? or as thoughtful and kind? or even as good-looking? she added, after exhausting all his other attributes. The idea of putting him out of her life entirely was so distasteful to her, she resolved to think no more about it—a little way she had with things she considered unpleasant, and which proved that she was, in her fashion, something of a philosopher.

Two weeks after Miss Schuyler's arrival in Boston, Mrs. Mortimer Stanton gave one of her famous dinners. When all were established in their places she glanced around the mahogany board at her guests and the perfect appointments, drew a little sigh, breathing content, and said that "it was well." She eyed Constance critically, affirming she had never seen her look better, and admiring again that proud little poise of head, more noticeable now that the curves of her neck and shoulders could be seen. Young Searles, who sat on her right, and between whom and Constance Mrs. Stanton hoped to make a match, said that he had never seen a head so well set, and that the poise was "bird-like," and made no secret of his admiration of it. And although Miss Schuyler had accepted and found rather pleasant his devotion on her previous visit, and knew that the Searles's ancient family tree, and the golden apples that hung from it, were hers if she chose to but reach forth her hand for them, she felt a little wearied now by his constant chatter, and turned to the man on her left, who was new material, and, she hoped, more interesting. Since those repentant telegrams she had received no word from Courtright. To be sure, he did not know her address, but he might easily have obtained that, she said, of her father or mother, if he had really cared for it, and she almost regretted not having sent him some little reply.

The enlivening hum of conversation around the table was broken by Mr. Stanton, who glanced across at his young guest, and said:

"By the way, Constance, a rather mysterious episode occurred in the office to-day that concerned you." The laughter and talk almost ceased.

"Some one called me up on the telephone, and said, 'Is this Mr. Mortimer Stanton of —— Beacon Street?' 'Yes,' I answered. 'Good,' he said; 'is Miss



CONSTANCE SAW COURTRIGHT STANDING BEFORE HER.

Schuyler visiting you?'" In the silence now the soft tread of the servants moving around the table was the only sound.

"I asked him what he wished of you, but he said, 'Oh, nothing, merely a package I have been commissioned to have delivered to her, and I wanted to make sure of her address.' He was going to shut me off, but I told him to hold on a minute and tell me who he was. Then he said his identity didn't make the slightest difference, as he was simply acting for another party."

Miss Schuyler's heart gave a bound, but she calmly reached for an olive.

"I pressed him still further," Mr. Stanton went on, "and he replied, a little impatiently, that it wasn't of the least importance, but that he was from the Treasury Department."

Every one looked at Miss Schuyler to see if she could solve the riddle, but she laughed, and said that it was probably a joke. Young Searles suggested that "perhaps the package was bank notes," and some one else asked if she "couldn't include them all in her 'pull' in the Treasury Department?" But in her heart she felt sure that Courtright was the "other party," and that with the aid of a friend in Boston he was hunting her out. The package, she thought, might be bonbons, or some conciliatory token, and she felt that in a few days she would hear from him; and the thought caused the dimples to break out around her mouth, and young Searles's conversation, even, to seem not so exhaustingly insipid.

She had wavered long between her strong inclination to forgive Courtright and the very just cause she felt she had to be angry with him. But she knew, now, what she should do.

The next day, when Mr. Stanton's solemn-faced "inside man" knocked on her door, and silently presented a salver with a box upon it, she knew that her heart had told her truly. The box contained clusters of great double purple and white violets, and a note, with the inscription in Courtright's masculine hand. She tore the envelope open, letting it drop to the floor, while she read the contents almost breathlessly. He said that as she had not answered the telegram ("sent in serial form to see if he could not amuse her, and take away from the seriousness of the situation"), nor written him even one line to say she forgave him, he supposed that she was still annoyed. And when he thought *why*, he blushed with shame at what he had done, and could say nothing in justification unless it was that their conversation in the brougham had made him not quite himself. And he sent her the violets, knowing she loved them, and hoped that they, in their sweetness, would plead for him better than he could for himself.

Miss Schuyler read the note through, then read it again, going over it as she used to a difficult page of her Psychology, in her schoolgirl days, until she could almost have repeated it backwards. She put the flowers in a cut-glass bowl, and set it among the silver things on her dressing-table. Then she went to find Mrs. Stanton, humming a snatch from the opera the Bostonians were singing, and told her that she really could not remain any longer than till Saturday.

The Van Houghtons gave a large reception in New York, a few days after Miss Schuyler's return, with "Dancing after eleven" on the cards. Constance attended with her mother, and held quite a little court, of people who said they were more than glad to see her at home again, and who asked the usual sarcastic questions about the Boston "savants." She chatted with them charmingly, listening all the while to the names announced at the door, and glancing occasionally in that direction. But midnight came, and Courtright had not appeared. She took an arm that was offered her, and moved slowly towards the ballroom, stopping in a small conservatory, for the moment vacant, while her escort went to bring her an ice. Her throat was parched, and she confessed to herself that the evening had not been a success. Then she buried her face in a cool bowl of roses standing near, half wishing that she were one of them. As she stooped there, some one moved swiftly across the floor, and a dark head almost touched hers on the other side, while a repentant voice inquired: "Did you give my love to Maria?"

Lifting her head, Constance saw Courtright standing before her, looking at her with twinkling eyes. Their expression was irresistible. She struggled with herself but a moment; then she threw back her head, and laughed as she had done when he first saw her in Colorado. When she stretched out her hand it was to put it in his, as she replied, "No—I didn't, but—I will."

“THE FLYING MAN.”

OTTO LILIENTHAL’S FLYING MACHINE.

By Vernon.

Otto Lilienthal

HERR OTTO LILIENTHAL, of Berlin, who has attained some celebrity as “The Flying Man,” was born forty-six years ago in the antiquated little city of Anklam, near the Baltic coast of Pomerania, about sixty miles to the northwest of Stettin. A residence so near the sea afforded him, in early life, many an opportunity of prosecuting his favorite studies and observations. In later years he migrated with his younger brother Gustav, his enthusiastic coadjutator in all his researches in the domain of aviatics, to Berlin, where he established, and is now conducting, a large manufactory of small steam-engines, whose mechanical appliances furnish him with every facility for the construction of his flying apparatus. He is an accomplished mathematician, and a close observer of nature; and is, besides, endowed in large measure with that poetic instinct which nearly always constitutes one side of even the most practical German character.

THE BIRD’S WING LILIENTHAL’S MODEL.

For more than twenty years Herr Lilienthal, with his brother’s aid, and in the intervals of more serious occupations, has been studying the subject of aërial navigation. He has taken the flying bird as his teacher. After many experiments with flat wings or plane surfaces, he became convinced that it was the gentle parabolic curve of the wing which enables a bird to sustain itself without apparent effort in the air, and even to soar, without a motion of the wings, against the wind. This he has demonstrated not only by experiment, but by an application of the doctrine of the resolution of forces to the action of the wind upon a concave surface. The circling ascents of the carrier-pigeon, as he rises when released, to gain a general view of the landscape, and to take his bearings before starting on his homeward journey, depend upon this principle. He *flies* with the wind, but he *sails* or *soars* against it. The fins of many fishes, and the web feet of aquatic birds, are strikingly analogous in construction. The sails of a ship assume a similar form. It would be impossible to sail so near the wind in beating, if the instrument of propulsion were a rigid flat surface. It is the effort of the sail to get away from the wind

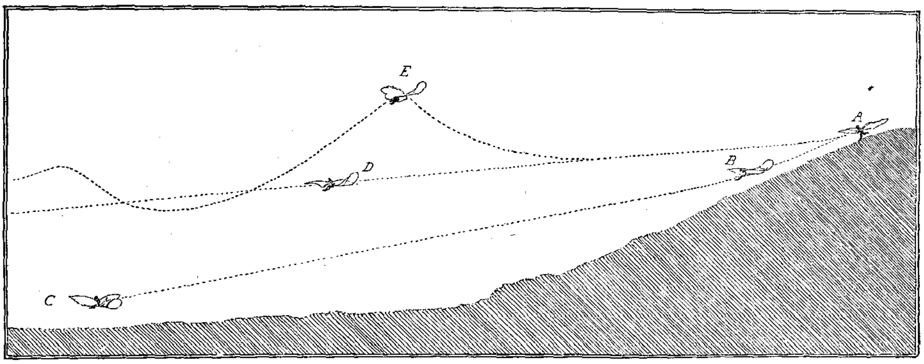
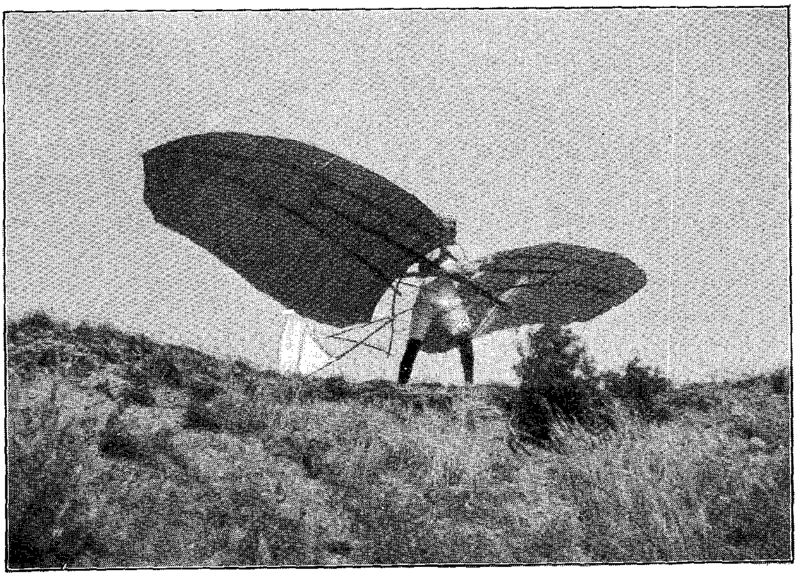


CHART OF A FLIGHT.

A. The start. *B.* The gliding descent. *C.* Alighting in still air. *D.* Course in ten-mile breeze. *E.* Soaring in a strong breeze.

which it gathers in its ample bosom which drives the boat forward, almost in the very teeth of the breeze.

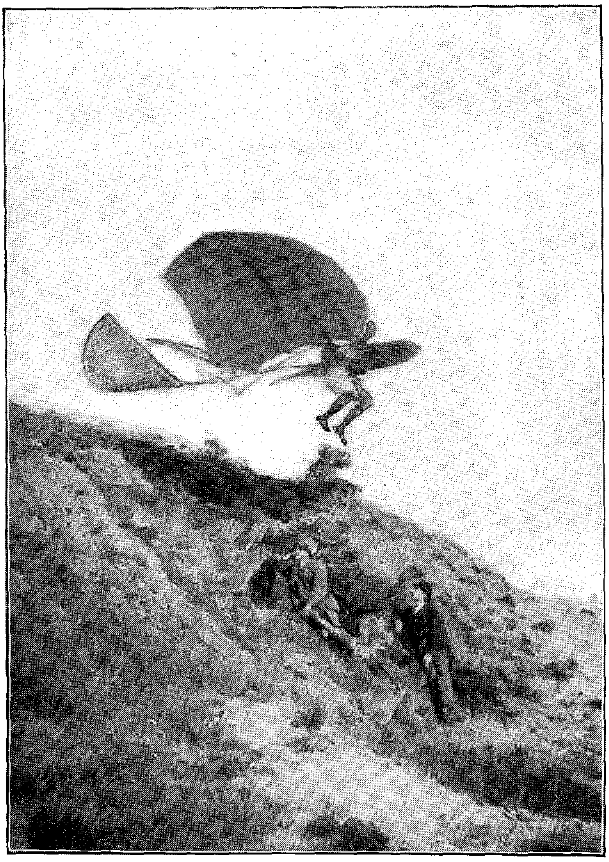
"There are still prominent investigators who *will not* see," said Herr Lilienthal to me, "that the arched or vaulted wing includes the secret of the art of flight. As we came upon the track of this idea, my brother and I, who were then young and wholly without means, used to spare from our breakfasts, penny by penny, the money to prosecute our investigations; and often the 'struggle for life' compelled us to interrupt them indefinitely. While we were devoting every moment of our spare time to the solution of the problem, almost every one in Germany regarded the man who would waste his energies in such unproductive labor as a fool. Years ago the most distinguished professor of mathematics in the Berlin Industrial Academy sent me word that of course it could *do no harm* to amuse myself with such pastimes, but warned me earnestly against putting any money into them. A special commission of experts, organized by the state, had, in fact, laid it down as a fundamental principle, once for all, that it was *impossible* for a man to fly. German societies for the promotion of aëronautics did not then exist, and those subsequently formed



PREPARING FOR A START FROM A HILL.

were devoted almost entirely to the interests of ballooning.

"I have always regarded the balloon, and the exclusive attention which it so long attracted, as a hindrance rather than a help to the development of the art of flight. If it had never been invented, it is probable that more serious investigations would have been prosecuted towards other solutions of the problem. Since the time of Montgolfier nearly all practical efforts have been directed to the improvement of the balloon. But it has nothing in common with the birds, and it is these that we must take as our model and exemplar. What we are seeking is the means of free motion in the air, in any direction. In this the balloon is of no aid; there is no relation between the two systems."

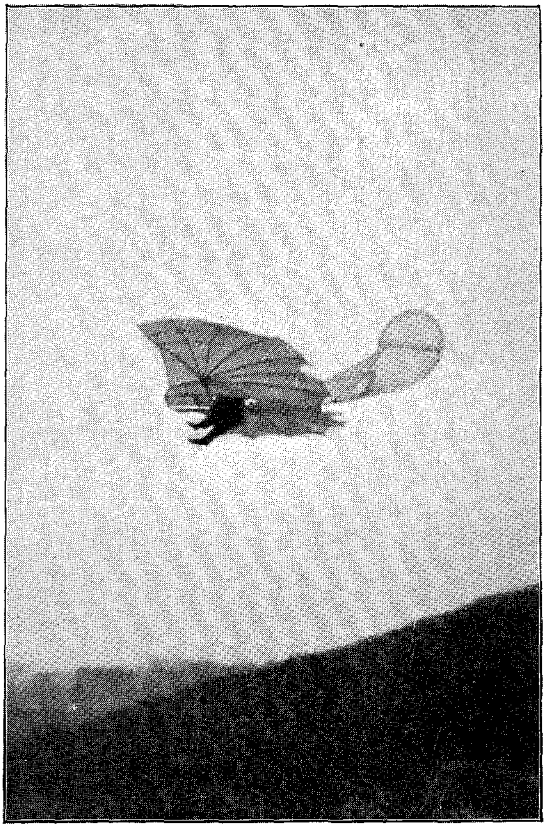


A START FROM A HILL.

THE WING OF THE BIRD.

The wing of a bird is divided into three parts, corresponding to the shoulder-joint, the fore-arm, and the hand and fingers of the human frame. The two former, composed largely of bones and muscles and tendons, are comparatively heavy, and their rapid movement demands the expenditure of considerable physical force; the last consists almost entirely of "pen-feathers," or pinions, which move to a certain extent automatically. In the larger birds—the "sailers" or "soarers," which alone are to be considered here—the first two members, with their concave under surfaces, furnish the sustaining power; and the last, being at the greatest distance from the shoulder, or axis of motion, the chief propulsive force. The construction of each member is peculiarly adapted to its special purpose, and it is this which Herr Lilienthal has endeavored to imitate.

An oarsman, on his forward stroke, opposes the blade of his oar almost perpendicularly to the resistance of the water; as he lifts it at the beginning of the backward stroke he "feathers" it, or brings it into a nearly horizontal position, so that its edge cuts the air. The pinions of birds act in precisely the same way. There are other analogies between the wing and the oar. The back stroke of the oar occupies only about half the time of the "pull," and the up stroke of the wing bears about the same relation to the downward beat. Moreover, at certain inclinations of the wing, the upward stroke, while detracting little or nothing from the sustaining power, contributes to the forward movement. As the pinions separate in consequence of the action of the air from above, they present their concave surface obliquely to the resisting medium, and act like an oar in "sculling," which, whether moved to the right or the left, impels the boat forward. It is evident that this must greatly lighten the physical exertions of a bird in rapid flight, for in whichever direction he moves his wings he gains propulsive force.


SOARING IN A STRONG BREEZE.

To the conviction that concave or vaulted wings were essential to success, Herr Lilienthal was led not only by the examination of a great variety of natural wings, and by theoretical deduction, but by actual experiment. The means adopted for this purpose were ingenious and simple. He fitted up an apparatus in the form of the fly-fans found on the dining tables of clubs and restaurants, with two long arms revolving horizontally, to the ends of which surfaces of different kinds and degrees of curvature could be affixed in any required position. The motive power was furnished by a weight, and could be exactly measured. There was also an adjustment which enabled the observer to measure the lifting force of various surfaces, moving at different angles of inclination through still air. By this means Herr Lilienthal was enabled to reach conclusions which were of great value to him in the construction of his flying machine; and the most important of them was, that the most effective form of wing was that whose convexity, as measured by the versed sine of the arc, should be one-twelfth of the breadth of the wing, or of the length of the chord connecting the opposite edges.

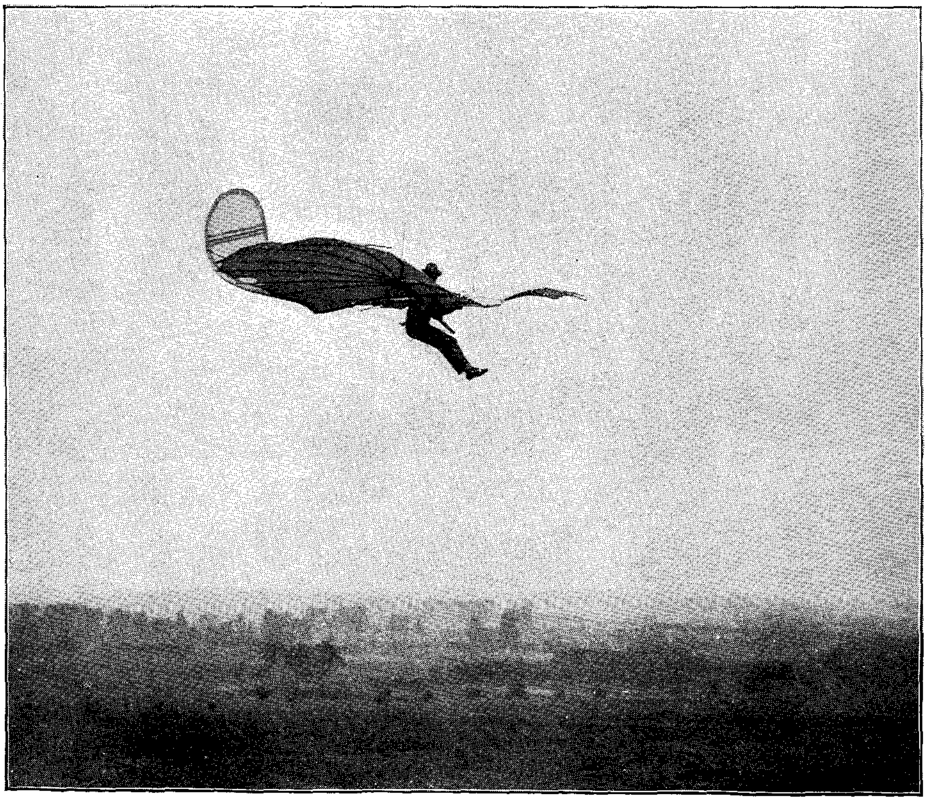
HERR LILIENTHAL'S WINGS.

The flying machine devised and now used by Herr Lilienthal is designed rather for *sailing* than for *flying*, in the proper sense of the term; or, as he says, "for being carried steadily and without danger, under the least possible angle of descent, against a moderate wind, from an elevated point to the plain below." It is made almost entirely of closely woven muslin, washed with collodion to render it impervious to air, and stretched upon a ribbed frame of split willow, which has been found to be the lightest and strongest material for this purpose. Its main elements are the arched wings; a vertical rudder, shaped like a conventional palm-leaf, which acts as a vane in keeping the head always towards the wind; and a flat, horizontal rudder, to prevent sudden changes in the equilibrium.

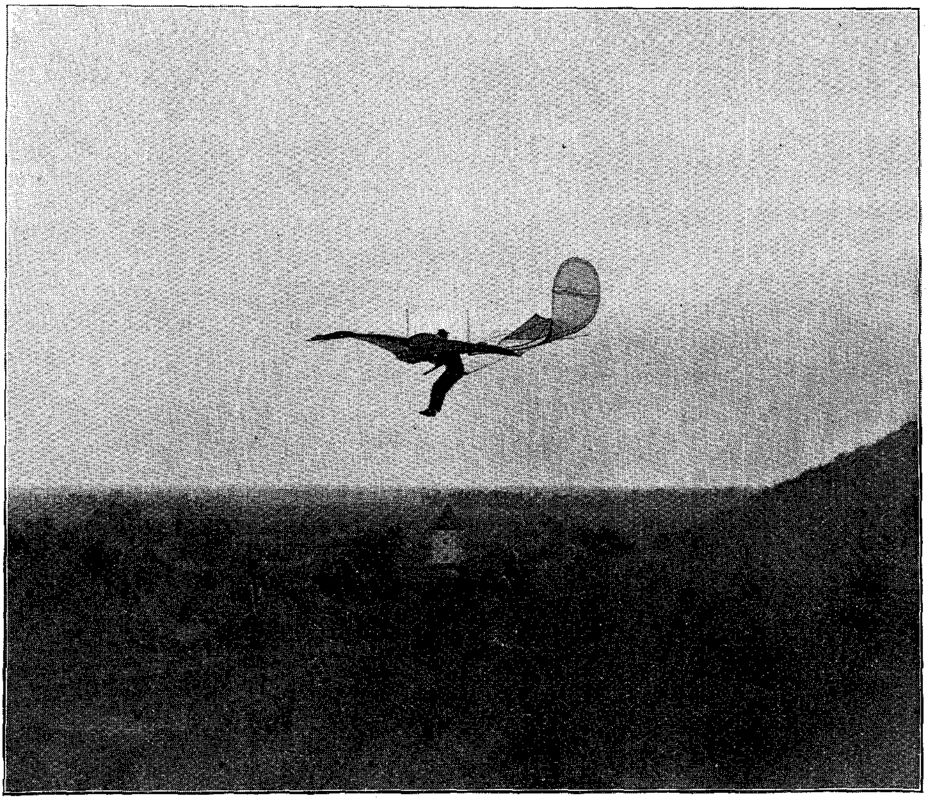
The operator so adjusts the apparatus to his person that, when in the air, he will be either resting on his elbows or seated upon a narrow support near the front. With the wings folded behind him, he makes a short run from some elevated point, always against the wind, and, when he has attained sufficient velocity, launches himself into the air by a spring or jump, at the same time spreading the wings, which are at once extended to their full breadth by atmospheric action ; whereupon he sails majestically along like a gigantic seagull. In this way Herr Lilienthal has accomplished flights of nearly three hundred yards from the starting point.

"No one," said Herr Lilienthal to me, "can realize how *substantial* the air is, until he feels its supporting power beneath him. It inspires confidence at once. With flat wings it would be almost impossible to guard against a fall. With arched wings it is possible to sail against a moderate breeze at an angle of not more than six degrees to the horizon."

The principle is recognized in the umbrella-form universally adopted for the parachute. Try to run with an open umbrella held above the head and slightly inclined backwards, and see what a lifting power it exerts. Mechanical birds have been constructed with flat wings, which, so long as the machinery operated, were able to sustain themselves moderately well and to fly rapidly ; but no one has yet succeeded in making any practical use of them. Their course has no intelligent direction; when the motive power gives out, they fall heavily to the earth. *Soaring*, in the sense of rising against the wind as the birds do, is possible only with dome-shaped wings. The aeroplane, or flat wing, when inclined at a certain angle to the breeze, may rise while its momentum continues ;



DESCENDING IN STILL AIR.



DESCENDING IN STILL AIR.

but this once overcome, its power is gone, and nothing can restore it.

PROPER DIMENSIONS FOR THE WINGS.

"The curve of a bird's wing," said Herr Lilienthal, "is parabolic; but the simple parabola differs so little from the arc of a circle that I adopted the latter curve as the more practicable, and the wings which I now use are, in the main, segments of a spherical surface. They are so constructed that they can be folded together like the wings of a bat, and require very little storage room when not in use.

"It was only gradually that I arrived at the proper dimensions. One does not easily gain an adequate conception of the materiality of the air, and my apprehensions led me at first to make the wings too large. I found that the varying force of the atmospheric currents, modified as they are by the undulations of the earth's surface, endangered my equilibrium in direct proportion to the spread of the wings. Those which I now employ are never more than twenty-three feet from tip to tip, and I am thus enabled, by a simple change of posture, so to alter the position of the centre of gravity as to restore the equilibrium.

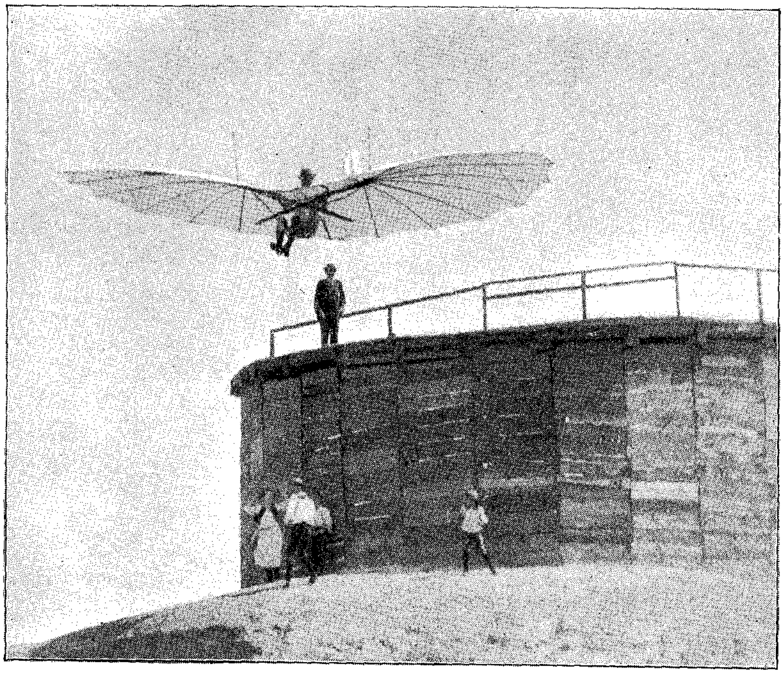
"There are limits also to the *breadth* of the wings, or their extension backwards. The operator must be able in a moment to transfer the centre of gravity so far to the rear as to overcome the action of the air, which might otherwise tend to throw him forward, and precipitate him to the earth. When one feels himself falling, the natural impulse is to stretch out the arms and legs in the direction of the fall; but it is one of the peculiarities of this mode of navigation that the movement must be in the contrary direction, or towards the *upper* side. The centre of gravity is thus shifted to the one side or to the other, forward or backward; and the pressure of the air, acting with greater force on the lighter and broader surface, soon restores the equilibrium. It is not easy to realize in practice at first, but after a short experience the movement becomes almost involuntary.

"When there is no wind, the apparatus acts simply as a parachute. The pressure of the air is directly from beneath, and is equal on all parts of the under surface. I have more than once found myself in this position, when I have utilized the speed attained in a gradual descent in rising to a greater height, in order to soar over some obstacle like a tree or a crowd of people. Under favorable circumstances it is easy to mount to a height even greater than that of the starting point, but the forward motion is thereby partially or wholly neutralized, and it may happen that one comes to a complete standstill in mid-air. In such cases it is only necessary to throw the centre of gravity so far back that the air shall act more powerfully on the forward surface, and the gradual gliding descent is resumed. So in landing I bend backward, exactly as a crow does when alighting in a field, and reach the ground without the slightest shock. The worst that is likely to happen in any case is the breaking of the apparatus; there is little danger to life or limb.

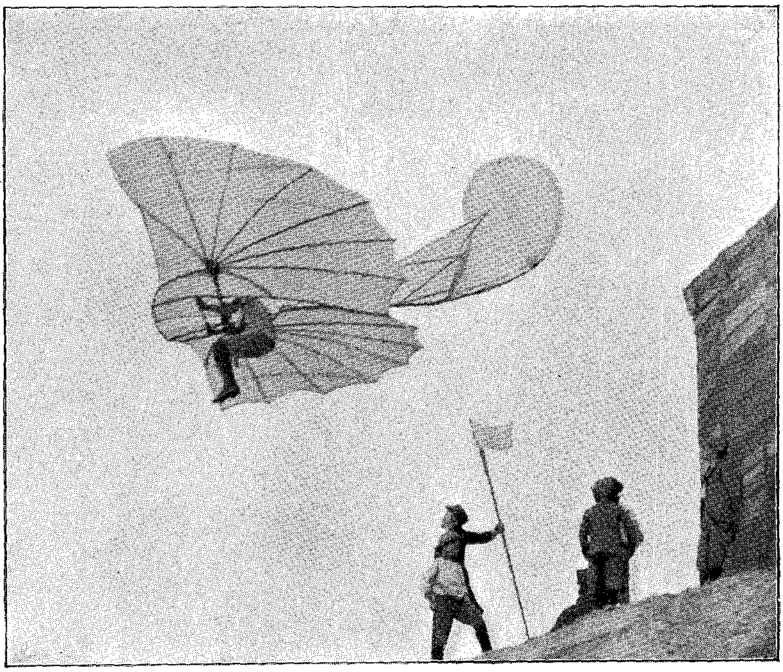
"I am far from supposing that my wings, although they afford the means of *sailing*, and even of *soaring*, in the air, possess all the delicate and subtle qualities necessary to the perfection of the art of flight. But my researches show that it is well worth while to prosecute the investigations farther."

THE LILIENTHAL MOTOR.

Having demonstrated the practicability of sailing and soaring, Herr Lilienthal has sought, in his recent experiments, to reach a practical solution of the problems of actual flight. The first difficulty to be overcome was the discovery of a suitable motor, without which all efforts to fly would be hopeless. If we estimate the ordinary weight of a man at one hundred and sixty pounds, and add to that the weight of the flying apparatus, we have a total burden of at least two hundred



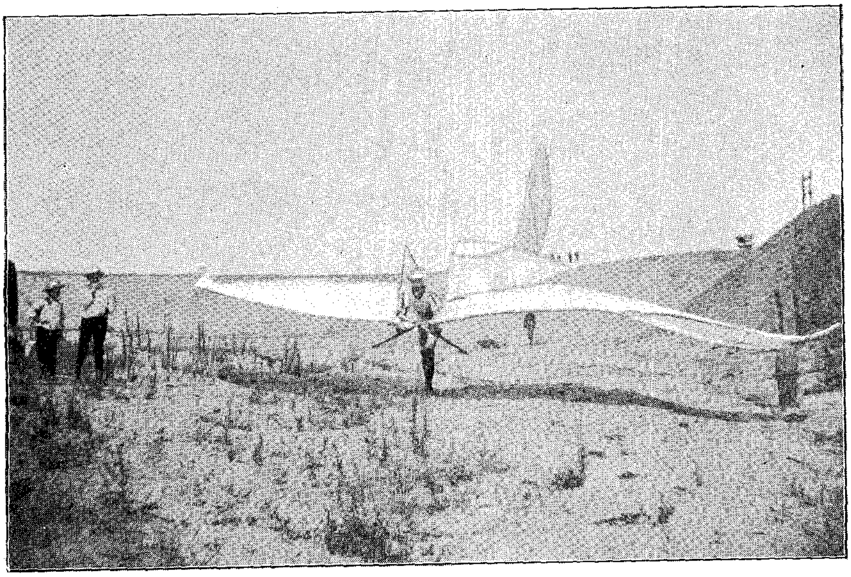
A START FROM A WALL.



THE DESCENT.

pounds to be raised and supported simply by aërial resistance. It is calculated that to overcome the attraction of gravity in such a case requires a force of one and one quarter horse power, which no man is able to exert for more than a very short time.

With such an apparatus as Herr Lilienthal's, steam engines and electric motors are not readily available; but he conceived the ingenious idea of employing, as a motive force, the vapor of liquid carbonic acid, which, under ordinary atmospheric pressure,



A SAFE LANDING.

boils at a temperature far below that at which mercury freezes. His engine requires no fire, nor boiler, nor steam-chest; only a diminutive cylinder with the requisite valve arrangements, which may be readily worked by hand, and a small reservoir of the liquid acid lying close beside it.

The one first constructed was of two horse-power, with a receiver to contain enough carbonic acid to last for two hours, and was attached to the front of the flying apparatus. The whole contrivance, with the necessary machinery to impart motion to the wings, added less than twenty-five pounds to the weight, and this will probably be reduced in future by the use of some alloy of aluminium, instead of iron, in the manufacture of the heavier portions. The wings were also fitted with rotatory pinions, constructed on the principles already indicated, and capable of automatic action under the pressure of the air.

The first experiments with this apparatus were rather *too* successful, at least in demonstrating the power of the engine. Unfortunately, the inventor had under-estimated the energy of his motor, which acted with such unexpected vigor that the wings were broken, and the modifications thus shown to be necessary will require some time for their completion. Herr Lilienthal confidently expects, however, eventually to solve the problem in this way.

ARE COMPOSITE PHOTOGRAPHS TYPICAL PICTURES?

By H. P. Bowditch, M.D., Professor of Physiology, Harvard Medical School.

THE determination of types or typical forms of natural objects is one of the most interesting as well as one of the most important subjects that can engage the attention of the biologist; for, in investigating the morphological relations between the various groups of organized bodies which form the subject matter of his study, the student of biology must necessarily have in his mind a more or less clear conception of the typical forms of the groups in question.

In determining, for instance, whether two allied groups of animals are to be regarded as varieties, or as distinct species, the naturalist will compare together not two individuals selected at random from each group, but two individuals carefully chosen for their conformity to what may be regarded as the average size, proportions, and general appearance of the group to which they belong.

In this selection of individuals as representatives of groups, a great deal will depend upon the experience and good judgment of the person making the selection, and two equally competent observers may differ materially in their choice of forms which they regard as typical. It is, of course, very desirable to remove this subjective source of error and to give to the typical form a truly objective character.

As far as size and proportions of the body are concerned, this result may be attained by measuring and weighing large numbers of individuals belonging to a given group, and from the figures thus obtained calculating by well-known statistical methods the mean or median values of the dimensions selected for study as well as the extent of individual variation from these values. From the relation which these dimensions bear to each other, typical forms may be deduced, which, though not accurately representing any individual in the group, are yet more truly *representative* of the group than any individual can be, for they are ideal forms round which individuals group themselves in accordance with the law of accidental variation, as shots group

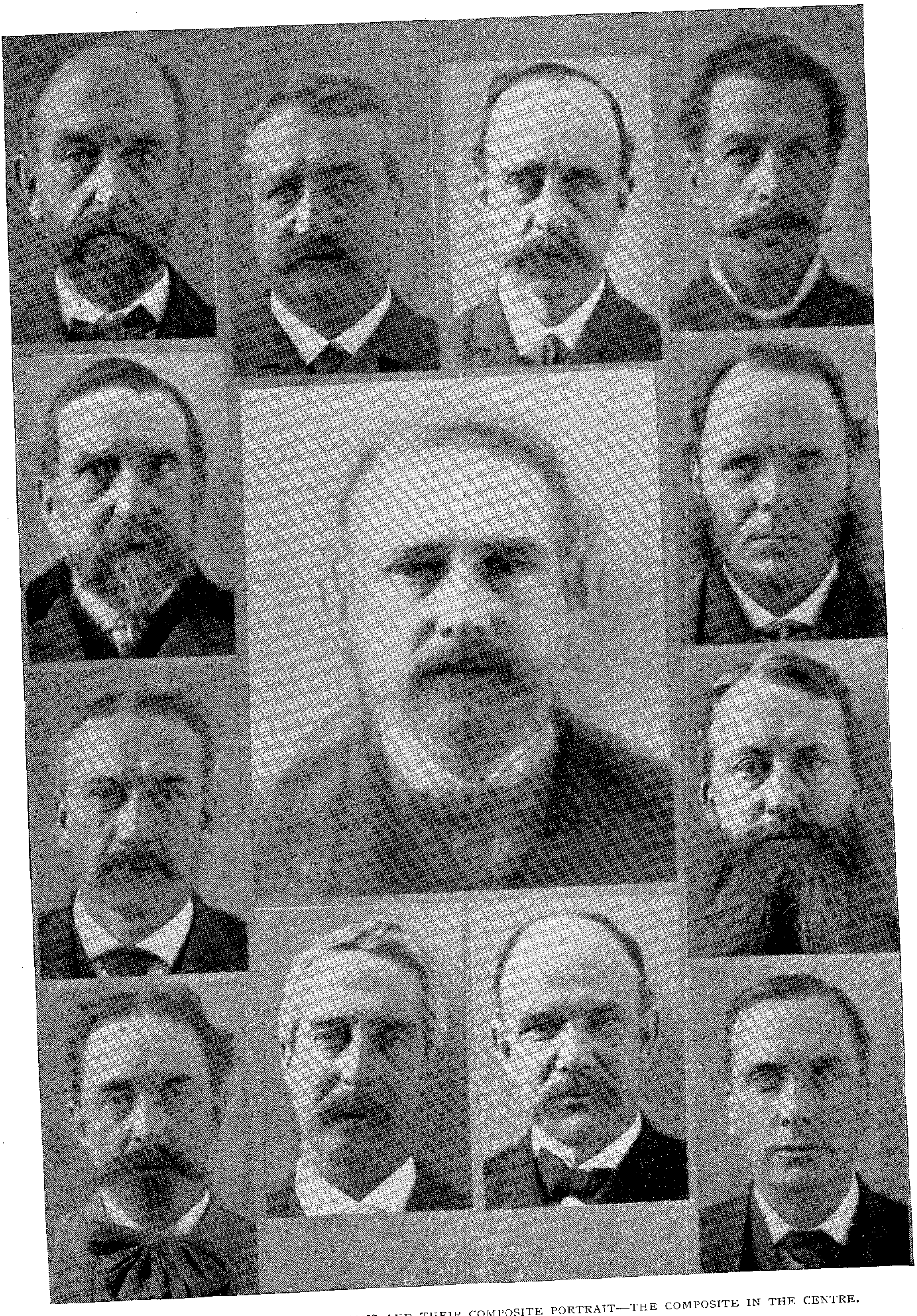


PLATE I. TWELVE BOSTON PHYSICIANS AND THEIR COMPOSITE PORTRAIT—THE COMPOSITE IN THE CENTRE.

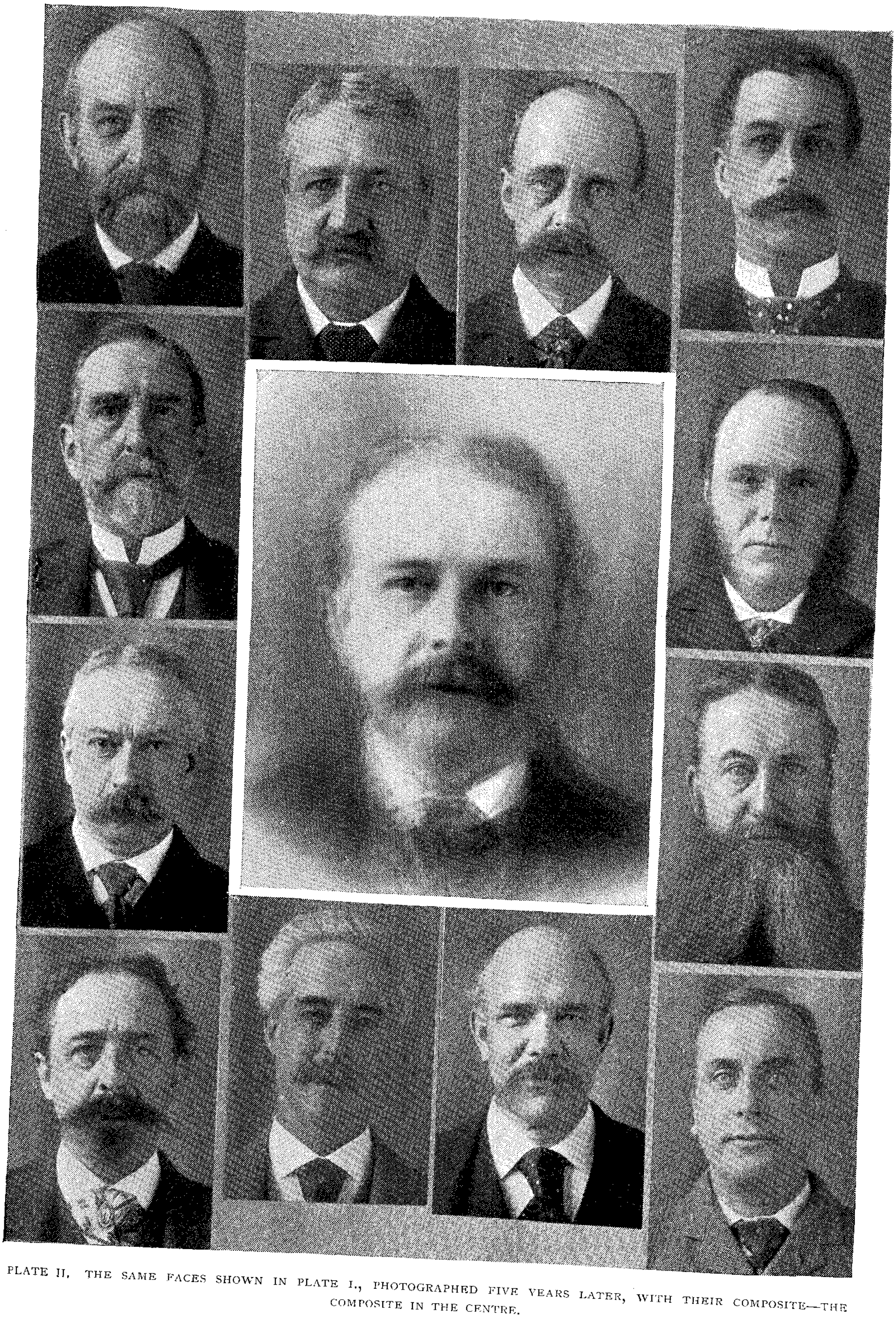


PLATE II. THE SAME FACES SHOWN IN PLATE I., PHOTOGRAPHED FIVE YEARS LATER, WITH THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

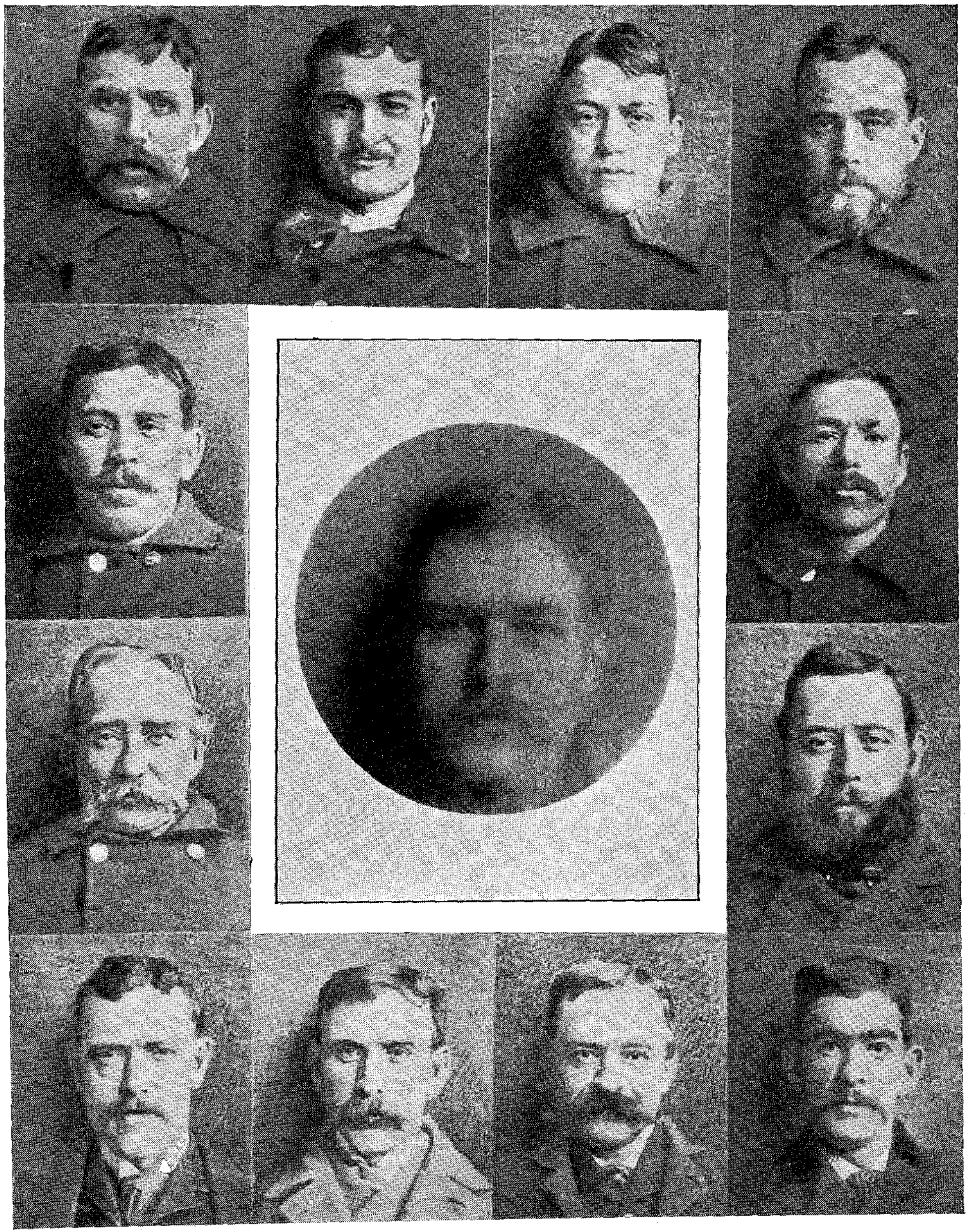


PLATE III. THE FACES OF TWELVE HORSE-CAR CONDUCTORS AND THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

themselves round the bull's-eye of a target. An illustration of the way in which an ideal figure may be constructed from physical measurements of a large number of individuals is afforded by the figures of the typical American students furnished by Professor D. A. Sargent for the educational department of the Columbian Exposition.

There are, however, certain anatomical peculiarities of too subtile a character to be expressed in figures, but producing results which reveal themselves with unerring certainty to the trained eye. The expression of the

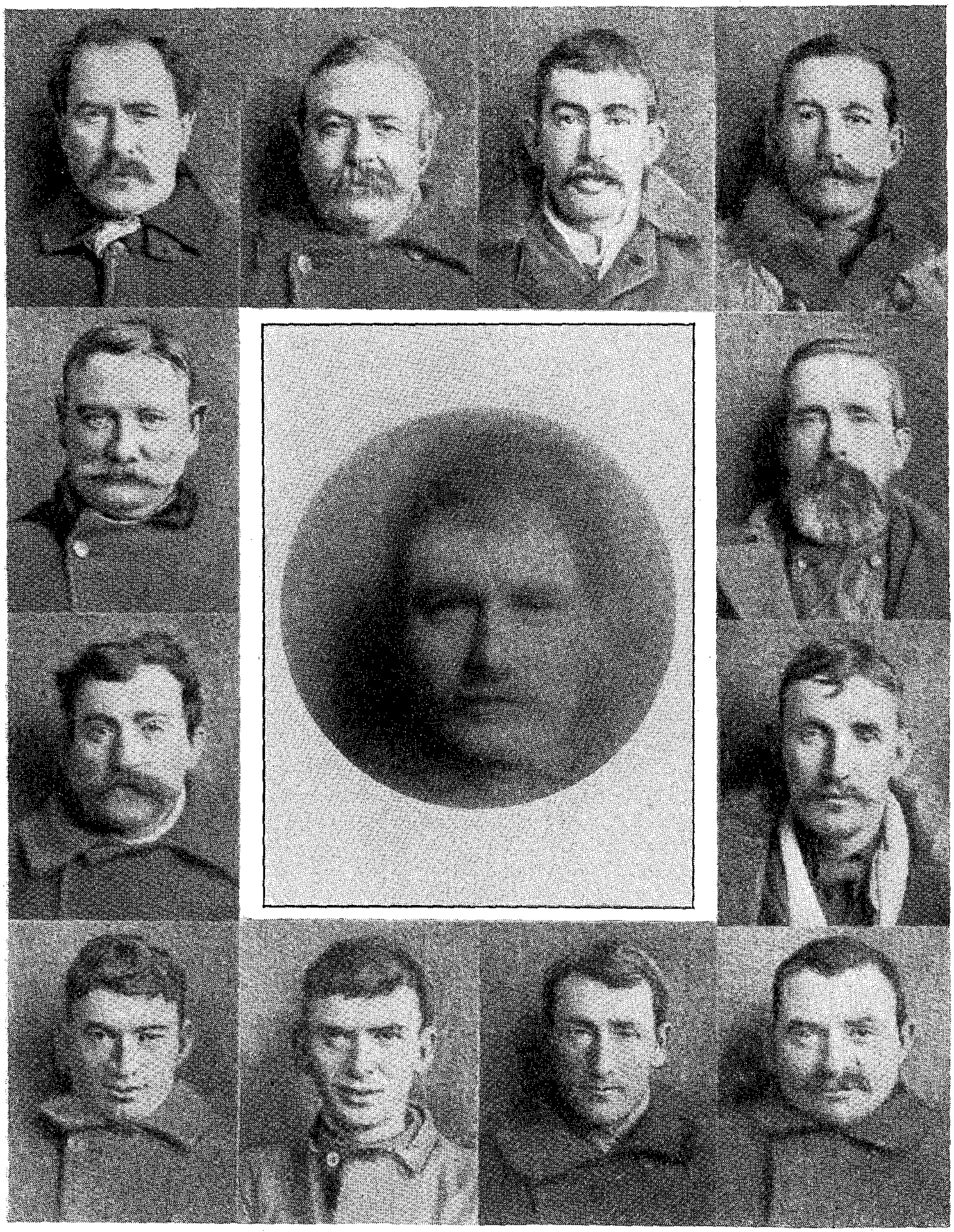


PLATE IV. THE FACES OF TWELVE HORSE-CAR DRIVERS AND THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

countenance, for example, depends entirely upon the complicated relations between the different parts of the skin of the face, but it is obviously impossible by the application of a measuring tape to distinguish between such faces, for instance, as those of an uneducated and of a liberally educated man. The eye, however, detects this difference at once. For the recognition of racial peculiarities the unmeasurable seem to be more important than the measurable differences. We say without hesitation: "This man looks like an Englishman, that one like a Russian," and we feel a greater confidence in the conclusion thus reached through the unaided eye than in the results of scientifically conducted cranial measurements. In forming a judgment of this sort we compare the individual in question with our mental conception of an Englishman or a Russian derived from previous observation of persons of those nationalities. Such a mental conception, unless derived from very extensive observation, is, of course, likely to vary very much in different individuals, owing to their varying experience in the observation of foreigners. This lack of anything objective in the conception of racial physiognomy renders scientific discussion of the subject quite impossible, and shows clearly the importance of devising some method by which mean or average values may be determined for those unmeasurable anatomical peculiarities upon which the expression of the countenance depends.

To Francis Galton belongs the credit of being the first to propose a solution of this problem. In his article on composite portraits ("Nature," May 23, 1878), he called attention to the possibility of employing the photographic camera to combine the features of a number of individuals upon the same sensitive plate, thus producing a typical portrait of the group by "bringing into evidence all the traits in which there is agreement," and leaving "but a ghost of a trace of individual peculiarities." Improved methods and the results of their application were described by the author in subsequent articles and in his work entitled "Inquiries into Human Faculty and its Development," published in 1883.

In 1886 and 1887 the subject attracted much attention in this country, and in many of the colleges composite photographs of the graduating classes were produced.

The strong family likeness which was observed between the composite portraits of these different groups of educated American youths was rightly regarded as evidence that the features thus produced are really typical of the groups in question, but the value of the process as a method of ethnological research does not seem to have been generally conceded. It certainly has not been utilized by ethnologists to establish types of national physiognomy in a way that might reasonably have been expected had Galton's opinion as to its importance been generally regarded as well founded.

It is evident, therefore, that a further inquiry into the value of composite photography cannot be regarded as superfluous, and the object of the present paper is to present certain additional evidence bearing upon the question whether the features and expression of a composite photograph are really typical of the group of faces from which it is obtained.

It is obvious at the outset that, since we are dealing with unmeasurable anatomical peculiarities, no such tests can be used as are applicable in the case of the measurable dimensions of the figure.

It is useless to try to determine, for instance, whether the dimensions of the features of the components group themselves round the corresponding features of the composite in accordance with the law of accidental variation, for we are not concerned with the size of the features, but with the expression of the countenance, which cannot be indicated by any numerical formula.

It would seem, therefore, that the only way to begin an inquiry of this sort is to study carefully the individual faces of a given group, asking ourselves what traits and expressions are common to them all, and then to ascertain whether these traits and expressions are faithfully presented in the features of the composite portrait. Let us examine in this way the faces shown in Plate I., which are those of a small dinner club composed of twelve Boston physicians, with the composite portrait in the middle. If we seek to discover traits which are common to the whole group, it will be evident that in two respects only do the features of each of these twelve faces present the same expression. In the first place, the faces are all those of middle-aged men, i.e., of men of about forty-five years of age; and, secondly, they are all faces

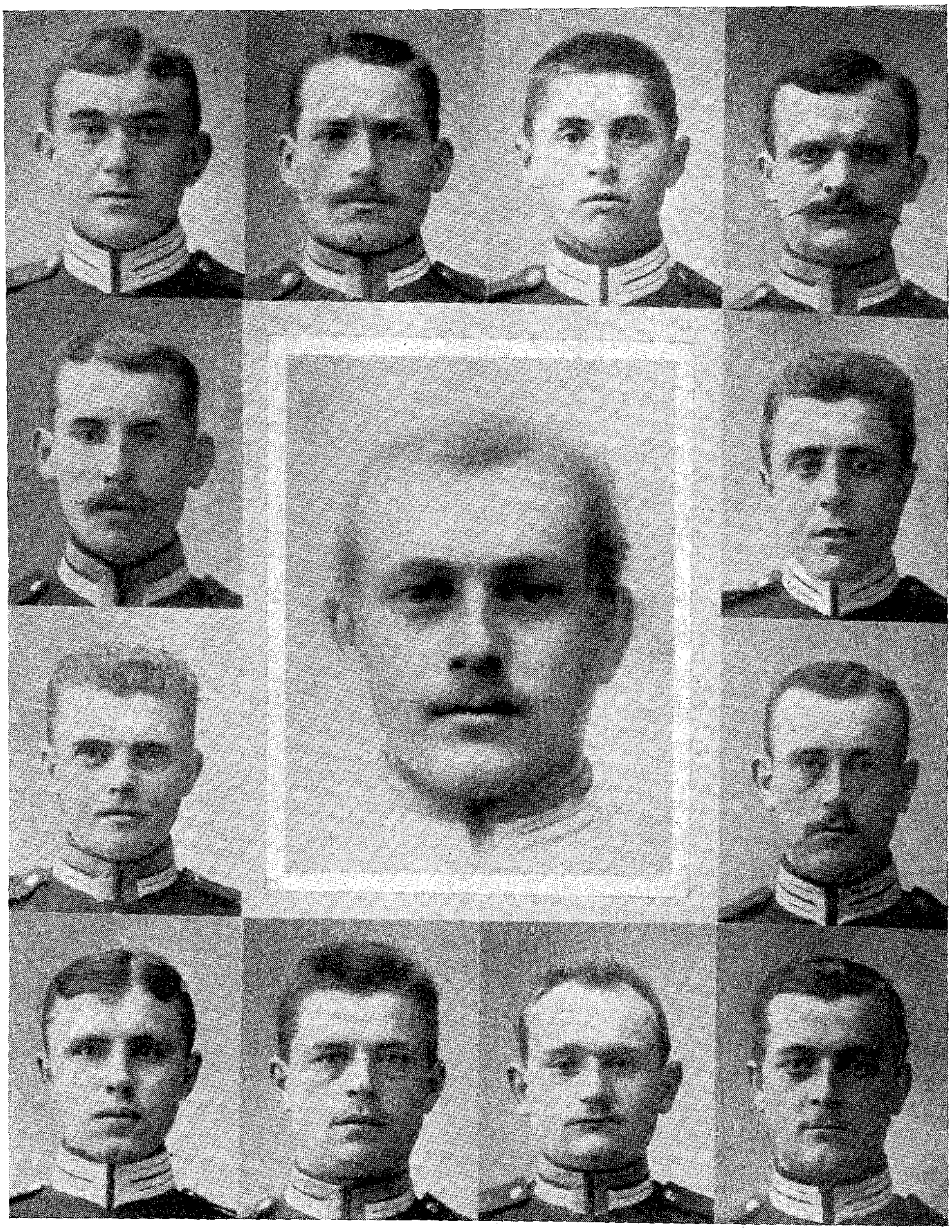


PLATE V. A GROUP OF SAXON SOLDIERS AND THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

of educated men. In no other respect do the faces seem to resemble each other.

Let us now consider whether the composite picture presents these common traits. Is this portrait that of a middle-aged educated man? There can be little doubt that an affirmative reply must be given to this question. The face is distinctly intellectual in its character, and the apparent age is not far from the average age of the components, viz., forty-five years.

The method of composite photography has, therefore, in this case, at any rate, produced a portrait which may be

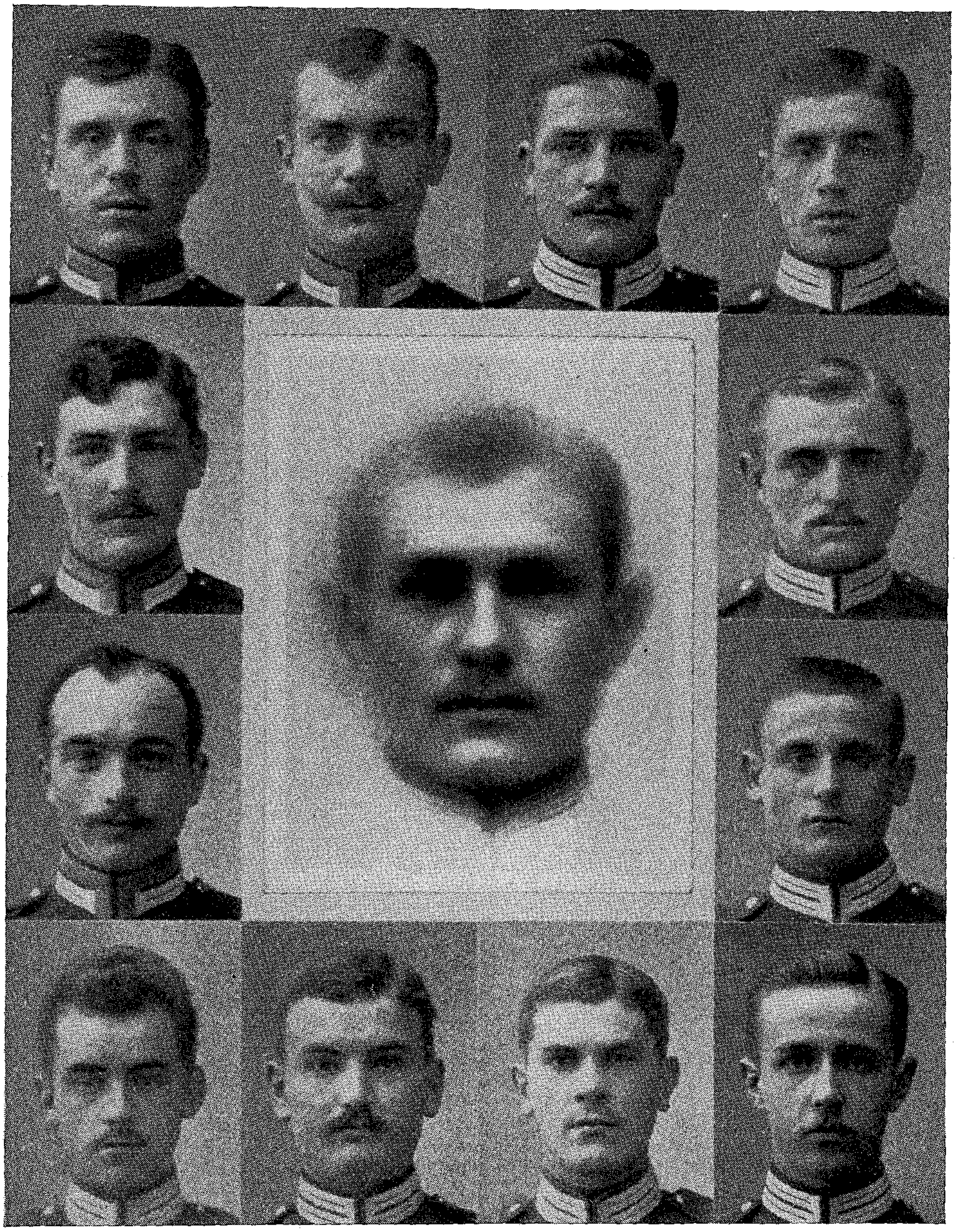


PLATE VI. A SECOND GROUP OF SAXON SOLDIERS AND THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

regarded as typical of the components, since its features fairly represent the group in respect to the only two qualities, namely, age and intelligence, in which the individual faces resemble each other.

As a further test of the value of composite photography, let us now compare this picture with others in which the components differ in age or in grade of intelligence, in order to ascertain whether corresponding differences reveal themselves in the composite portraits. To this end it will be found interesting to compare the component faces in Plate I. with the same faces

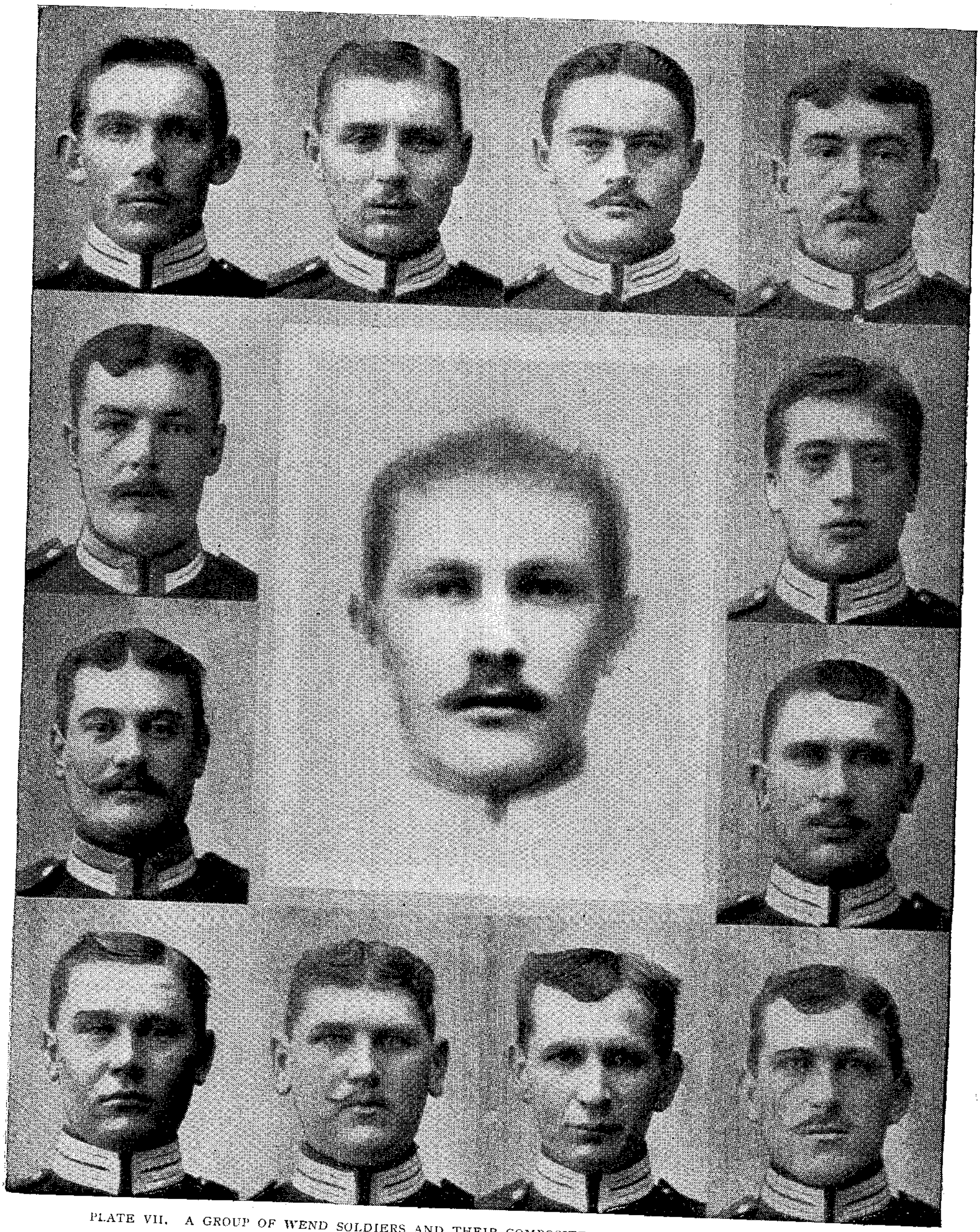


PLATE VII. A GROUP OF WEND SOLDIERS AND THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

photographed five years later, as shown in Plate II. It will be noticed in the first place that the interval of five years has in most cases made little difference in the apparent age of the individual members of the group. This is what might be expected, for the faces are those of men who are all upon the plateau of middle life, where the passing years leave much less trace than at earlier and later periods. Except that the expression of the countenance is, perhaps, in general, rather less grave in the later than in the earlier photographs, it is not easy to discover any change which can be regarded as presenting itself in the whole group.

If we now compare the composite pictures it will be seen that the difference in the apparent age of the two portraits is not more marked than in the case of the components. Most persons will be inclined to regard the later picture as that of a slightly older man, but the opposite opinion has also been expressed. The countenance of the composite seems to have become, during the interval of five years, less serious and student-like, and perhaps rather more philosophical, in its expression. There is always, however, room for a difference of opinion in interpreting the expression of the somewhat vague and shadowy features of a composite photograph.

Owing to the slight difference in the age of the components in these two pictures, their comparison cannot be said to show conclusively how far the process can be depended upon to produce a face of an apparent age representing that of the components. The test might be very easily applied by collecting photographs of school children, producing composites of those of corresponding ages, and then ascertaining whether the portraits thus obtained arrange themselves in a natural series representing successive ages.

Let us now compare the group of professional men and their composite with similar groups of men who have not enjoyed the advantage of a liberal education. On Plate III. are exhibited the faces of twelve horse-car conductors, and on Plate IV. those of the same number of horse-car drivers. A study of either the components or the composites of these three groups shows clearly that, with respect to intellectual expression of countenance, the conductors occupy a position intermediate between that of the professional men and that of the drivers.

We have thus three groups of portraits, the doctors, the conductors, and the drivers, each group characterized by a different grade of intellectual development, and that grade fairly constant within each group. Now, since the composites of these groups show a corresponding difference, it seems to be a reasonable conclusion that, as far as intelligence is concerned, the composite portrait fairly represents the typical physiognomy of the group to which it belongs.

Additional evidence on this point could be obtained by uniting in the same group intellectual and unintellectual faces in varying proportions, and ascertaining whether the composites of the groups thus formed would arrange themselves in a natural series in which the degree of intelligence displayed in the countenance increased with the relative proportion of the intellectual over the unintellectual faces. Should circumstances favor the undertaking, a study of this sort may at some future time be attempted.

Since the method of composite photography seems to be capable of producing a portrait which is intellectually typical of the group from which it is taken, we are encouraged to hope that for those differences of feature which distinguish the various branches of the human race the same process may also prove useful and may furnish us with an objective basis for the study of racial physiognomy, in place of the purely subjective conceptions upon which we are now compelled to rely.

As a contribution to this study, four groups, each of twelve soldiers with their composite, are presented in Plates V. to VIII. The original photographs, which are all of soldiers belonging to the Saxon army, were obtained through the kindness of General von Funcke of Dresden. The soldiers represented in Plates V. and VI. belong to Saxon regiments, while those shown in Plates VII. and VIII. are Wends. The latter are a Slavic race, and thus ethnologically belong to a very different branch of the human family from the Saxons. It is, of course, not to be supposed that either Saxons or Wends are at the present time, in any sense, a pure race, but they are sufficiently distinct to be enrolled in separate regiments, and in Saxony it is generally considered that the Wends are a sturdier and more vigorous race than the Saxons. A study of the faces here presented cer-

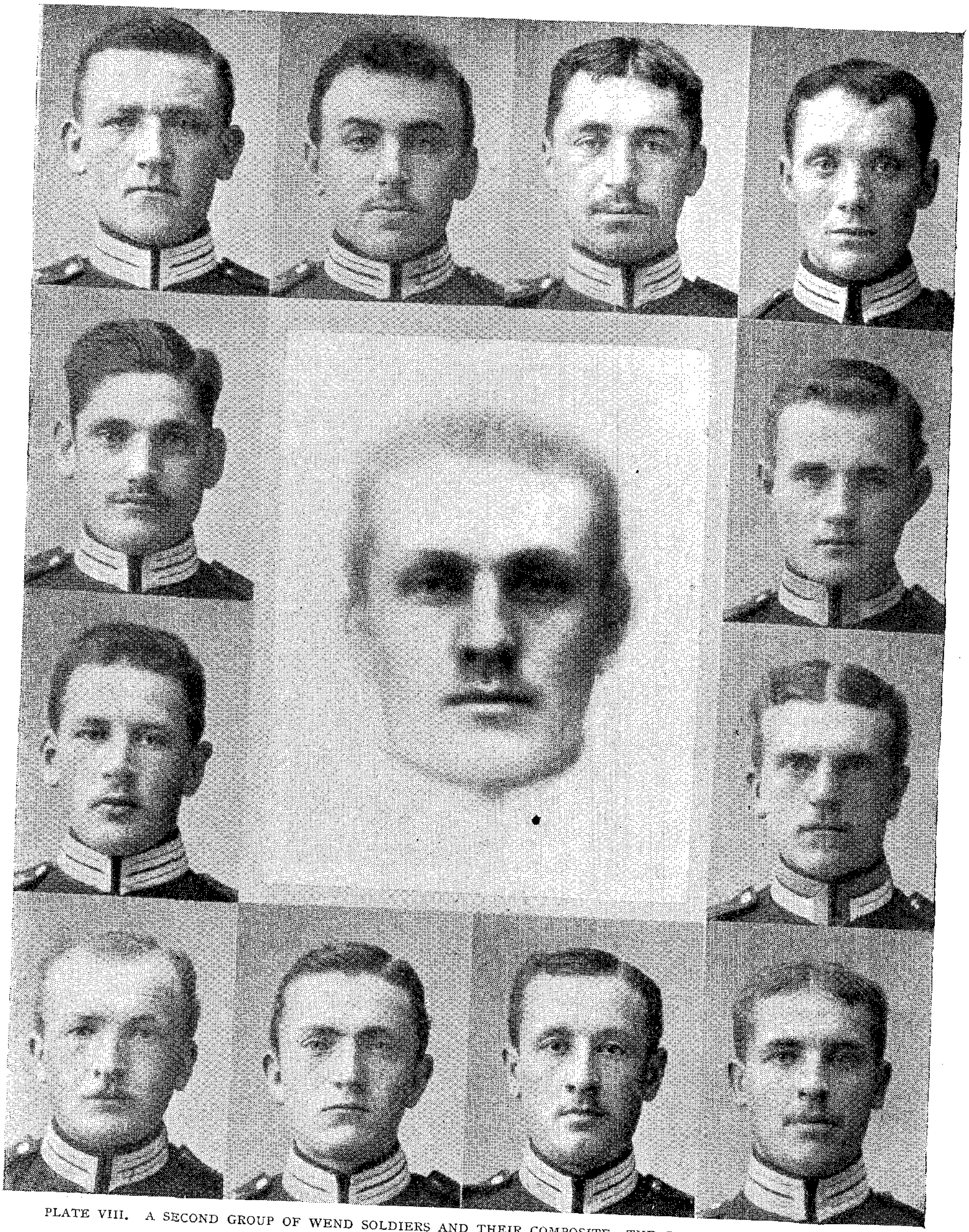


PLATE VIII. A SECOND GROUP OF WEND SOLDIERS AND THEIR COMPOSITE—THE COMPOSITE IN THE CENTRE.

tainly suggests the conclusion that there must be some racial peculiarities showing themselves in the composite portraits. The two composites of each race are clearly more like each other than like those of the other race, and the squarely cut jaw and brow of the Wend composites give the impression of greater vigor and strength of character than the more rounded features of the Saxons. The beautifying effect of the process is very clearly shown in these pictures, an effect which Galton has explained by the fact that the features of the composite are always regular, since the irregularities due to individual peculiarities necessarily disappear from the final result.

The question whether composite photography is likely to be an important method of ethnological research can be answered only after it has been extensively employed by experienced anthropologists. All that can be claimed for the present investigation is, that its results are sufficiently encouraging to justify a further prosecution of the work.

In judging of the value of the evidence here presented, it is proper to bear in mind that, even by the best processes of mechanical reproduction, photographs lose something of their delicacy and beauty, and that this is particularly the case when the photographs are lacking in clearness. It is for this reason that, in spite of the persistent efforts of the publishers, for which the writer desires to express his grateful thanks, it has been found impossible to reproduce satisfactorily the photographs of the horse-car conductors and drivers, for these pictures were taken under rather unfortunate conditions, and the original negatives lacked many of the qualities of a good photograph.

The process of making composite pictures is exceedingly simple, and the necessary apparatus very readily constructed. In the appendix to his "Inquiries into Human Faculty," Galton has described the very elaborate and perfect form of apparatus which he has used in his studies; but entirely satisfactory results may be obtained with much more simple contrivances. The instrument used by the writer is merely an old-fashioned box camera, with a hole cut in the top for the reception of the ground-glass plate upon which the image is to be reflected for purposes of adjustment. The reflection is effected by a mirror set at an angle of forty-five degrees in the axis of the camera, and pivoted on its upper border so that, after the adjustment of the image, the mirror can be turned against the upper side of the box, and the image allowed to fall on the sensitive plate at the back of the camera. The original negatives are used as components, and are placed in succession in a small wooden frame which is pressed by elliptical springs against a sheet of glass fastened vertically in front of the camera. By means of this arrangement it is possible to place each negative in succession in any desired position in a plane perpendicular to the axis of the camera, and thus to adjust it so that the eyes and the mouth of its optical image shall fall upon the fiducial lines drawn upon the ground-glass plate at the top of the camera. An Argand gas burner with a condensing lens furnishes the necessary illumination.

For our amateur photographers, who are constantly seeking new worlds to conquer, the opportunity of doing useful work in developing the possibilities of composite photography ought to be very welcome. Not only will the science of ethnology profit by their labors, but by making composites of persons nearly related to each other, a new and very interesting kind of family portrait may be produced. The effect of occupation on the physiognomy may also be studied in this way. By comparing, for instance, the composite of a group of doctors with that of a group of lawyers, we may hope to ascertain whether there is such a thing as a distinct legal or medical physiognomy. The experiments made some years since by Professor Pumpelly in combining the naturalists and the mathematicians of the National Academy into two composite portraits * justifies the hope that very interesting results may be expected from this method of investigation.

Apart from the value of the conclusions to be drawn from such experiments, the process itself is one of the most interesting that can occupy the attention of a photographer. The unexpected beauty of the positive picture slowly revealing itself in the developing tray imparts a fascination to the pursuit unequalled in any other kind of photographic work.

As a subject at once attractive and important, these investigations are to be commended to all who are interested in photography either from an artistic or a scientific point of view.

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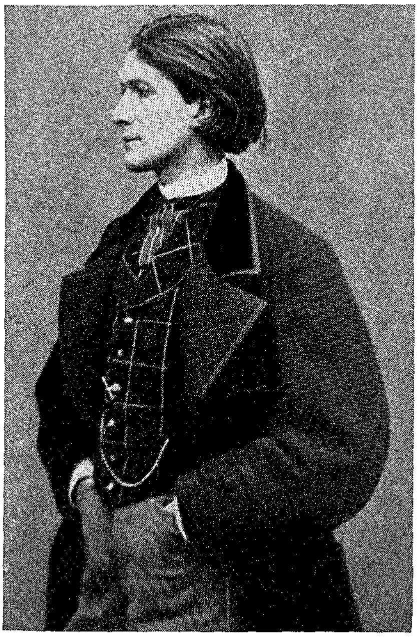
* See "Science," May 8, 1885.

"HUMAN DOCUMENTS."

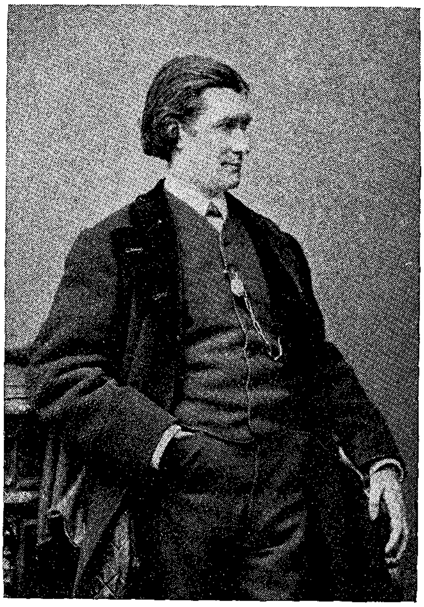
BIOGRAPHICAL NOTES.

VICTORIEN SARDOU, the most popular of French dramatists, was born in Paris, September 7, 1831, and is the son of Léandre Sardou, a professor and also a writer. He studied medicine, and was for a time a private instructor in history, philosophy, and mathematics. His first play was produced in 1854, and proved a complete failure. For several years his life was one of the severest want and struggle. He lived in a garret and suffered a severe illness. But he was tenderly nursed by a neighbor, Mlle. de Brecourt, whom a year later he married ; and, when the tide turned with him, his prosperity flowed in a perfect flood. He made another attempt on the stage, and, through the aid of his wife, formed a valuable connection. Since 1859 he has produced a play or two a year, and his best pieces have enjoyed long "runs." English and American managers and actors, no less than French, have been glad to avail themselves of M. Sardou's "fetching" qualities, and a number of his best plays have had their first production in England or America. Neither in France nor elsewhere, however, have the critics got quite as much pleasure out of Sardou's work as have the ordinary playgoers.

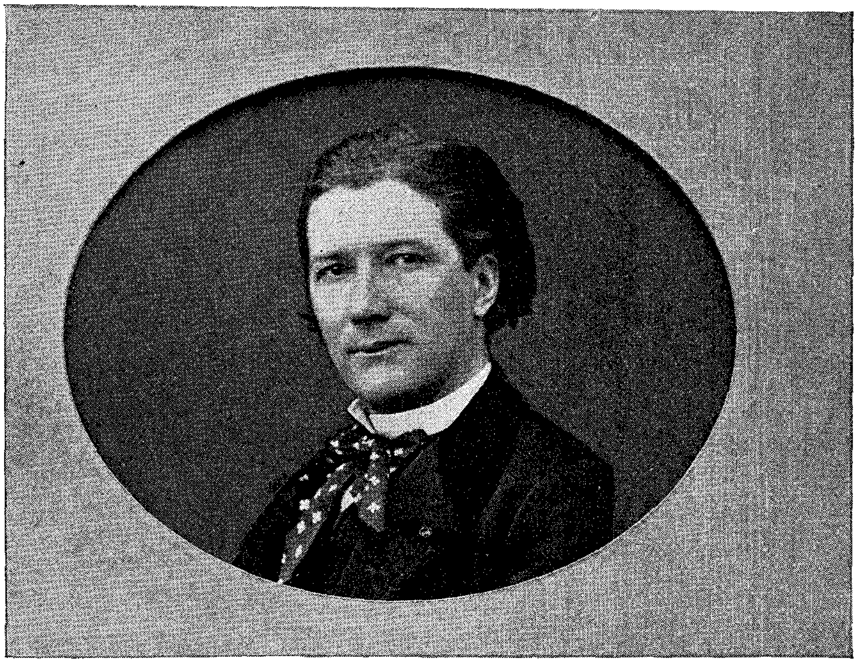
FANNY JANAUSCHEK, the tragic actress, whom most people suppose to be a German, and who, by virtue of long residence, might be claimed for an American, is by birth a Bohemian, having been born at Prague, July 20, 1830. She began her stage career young, and was playing acceptably in Frankfort, Germany, as early as 1848. She had previously undergone a careful training in Cologne. She continued playing in Frankfort until 1860. Then she made a tour of German cities, and in 1867 began her first tour of the United States. She remained here until 1871, and, though she played only in German, she was received with the highest favor. She made a second tour of the United States in 1873 and 1874, and, playing then in English, carried her fame still higher. In 1874 she returned to Germany, but subsequently came again to the United States, and here she closed her professional career. Closed it practically now is, though she does still occasionally appear. She lives retired in Brooklyn, New York.



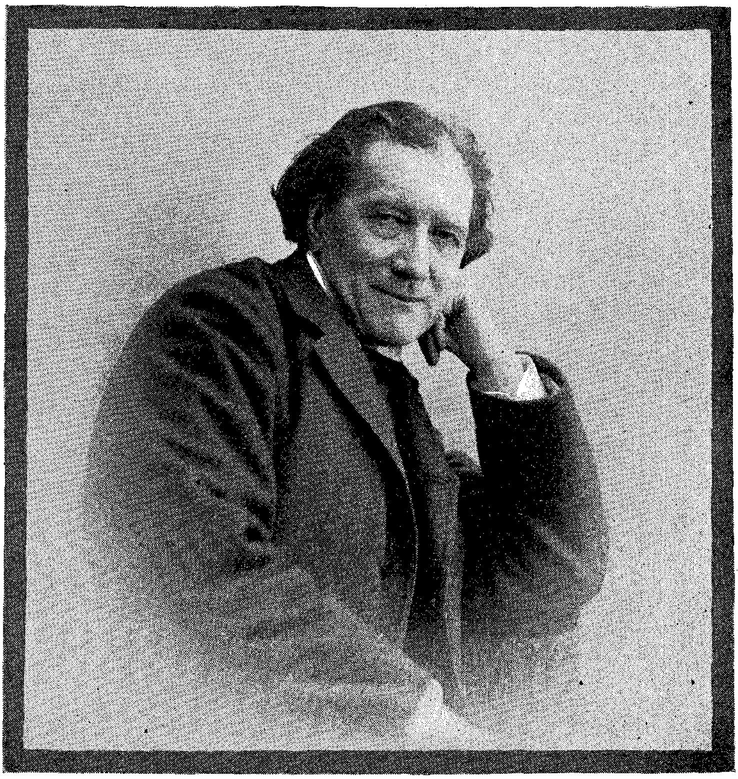
1861. AGE 30.



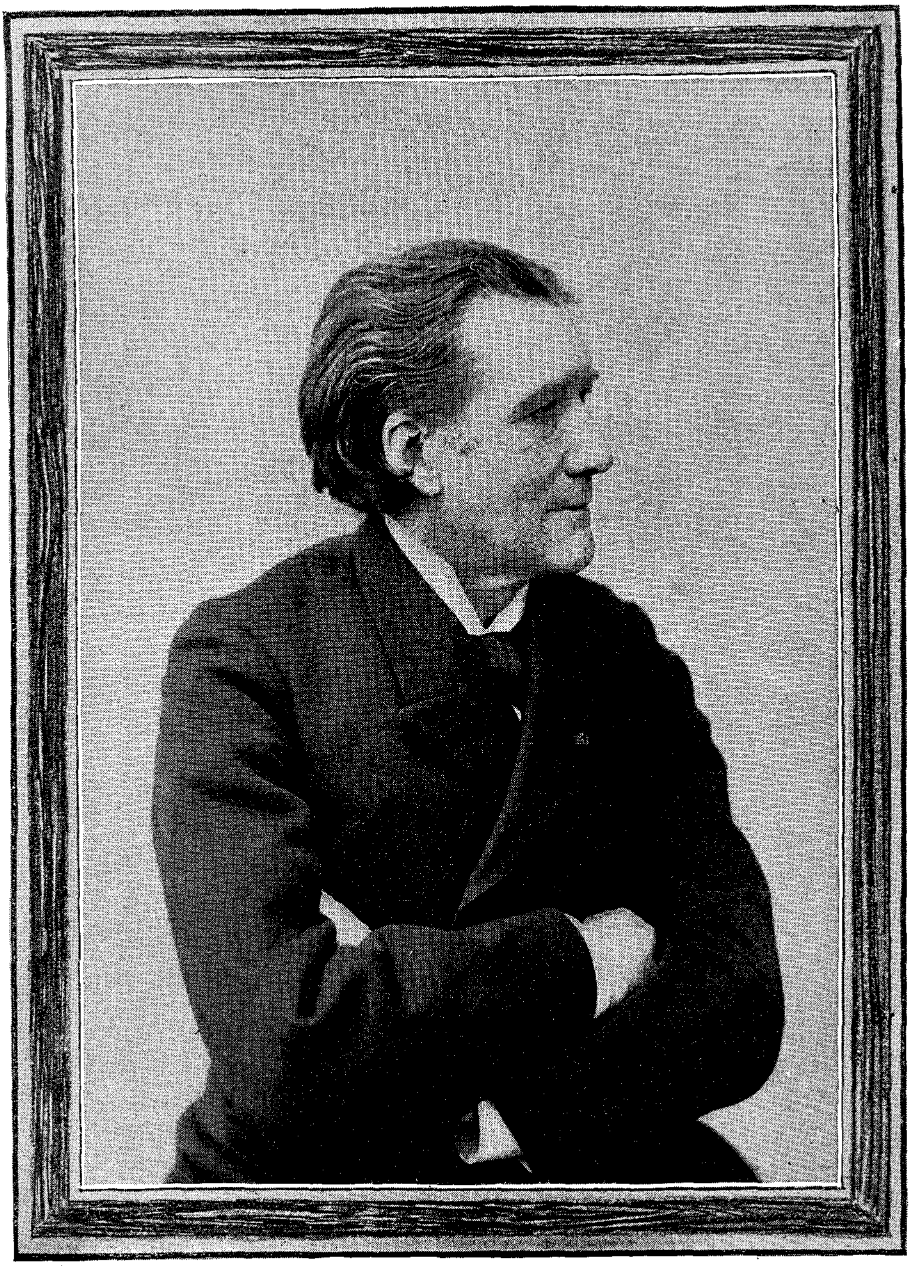
ABOUT 1865. AGE 34.



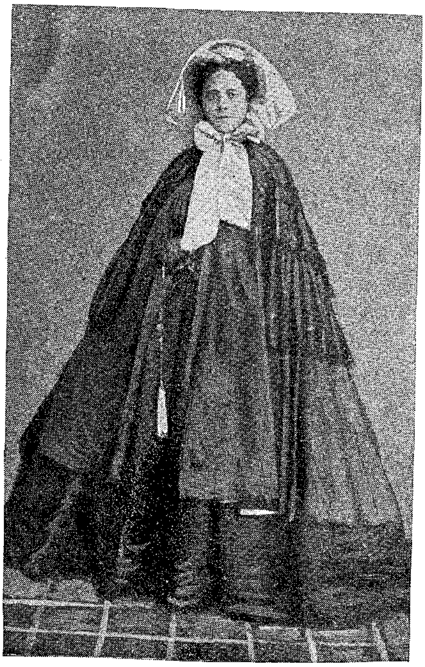
1874. AGE 43.



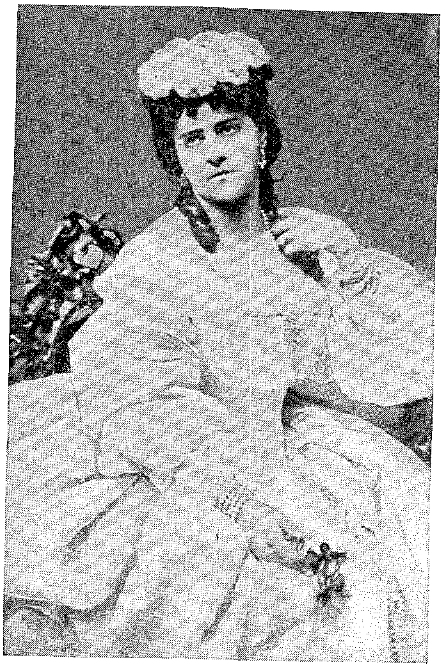
1887. AGE 56.



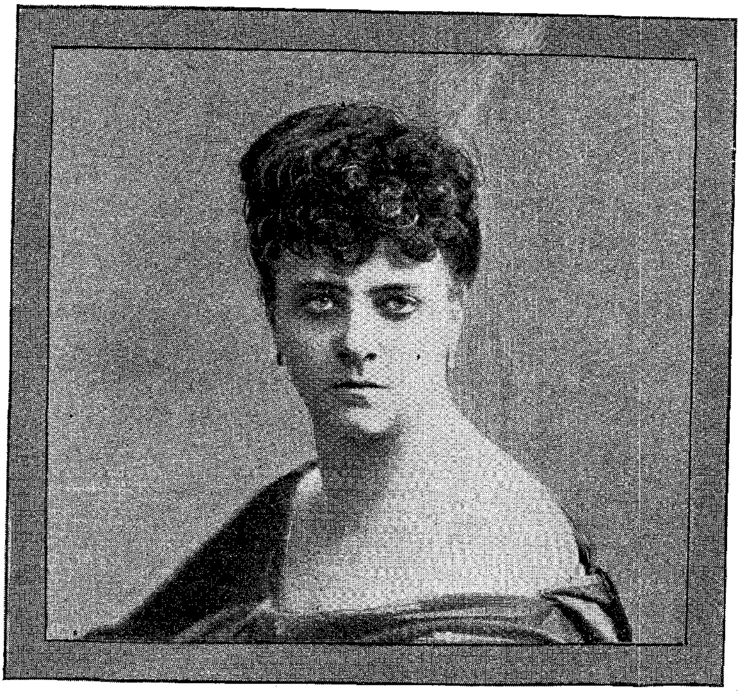
1891. AGE 60.



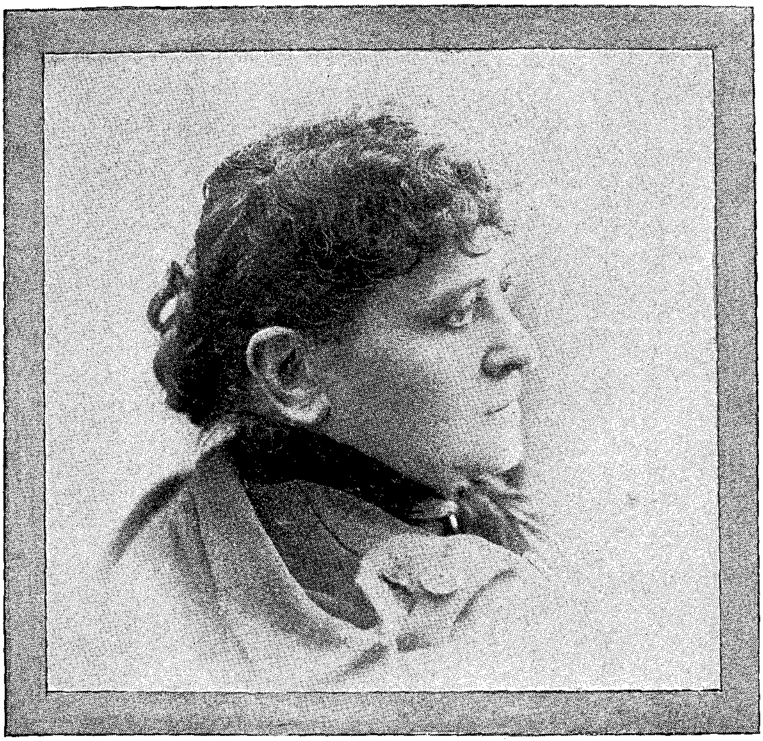
AGE 34. 1864.



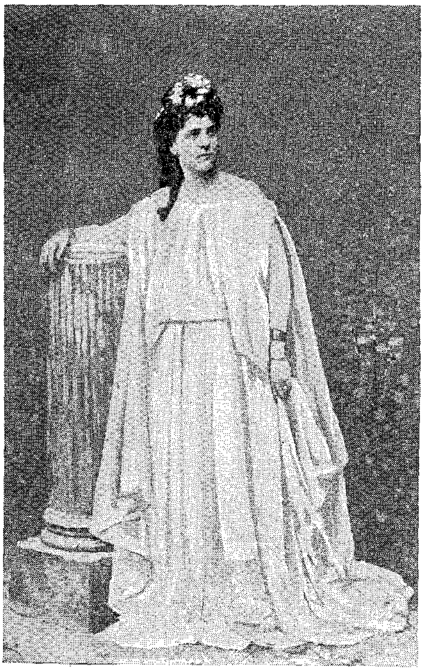
AGE 37. 1867.



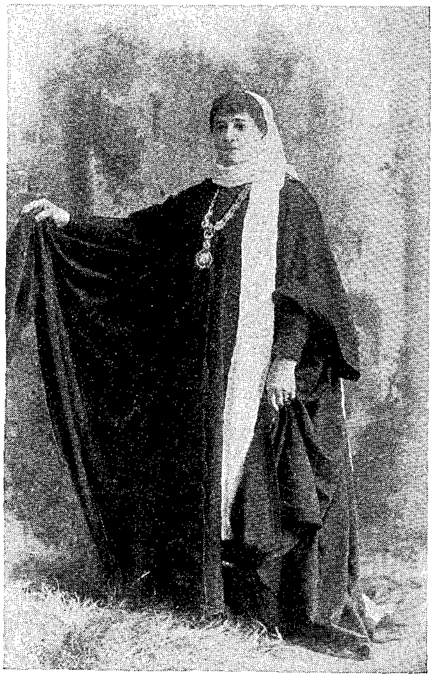
AGE 41. 1871. FROM A PHOTOGRAPH BY SARONY.



AGE 60. 1890. FROM A PHOTOGRAPH BY BAKER, COLUMBUS, OHIO.



AGE 38. 1868. JANAUSCHEK AS "IPHIGENIA."



AGE 60. 1890. JANAUSCHEK AS "LADY MACBETH."

THE FINDING OF FINGALL.

BY GILBERT PARKER.

"*FINGALL! Fingall!—Oh, Fingall!*"

A gray mist was rising from the river, the sun was drinking it delightedly, the swift blue water showed underneath it, and the top of White-faced Mountain peaked the mist by a hand-length. The river brushed the banks like rustling silk, and the only other sound, very sharp and clear in the liquid monotone, was the crack of a woodpecker's beak on a hickory tree.

It was a sweet, fresh, autumn morning in Lonesome Valley. Before night the deer would bellow reply to the hunters' rifles, and the mountain goat call to its unknown gods; but now there was only the wild duck skimming the river, and then rising and fading into the mist, the high hilltop, the sun, and again that strange cry: "*Fingall!—Oh, Fingall! Fingall!*"

Two men, lounging at a fire on a ledge of the hills, raised their eyes to the mountain-side beyond and above them, and one said presently:

"The second time. It's a woman's voice, Pierre."

Pierre nodded, and abstractedly stirred the coals about with a twig.

"Well, it is a pity—the poor Cynthie!" he said at last.

"It *is* a woman, then. You know her, Pierre—her story?"

"*Fingall! Fingall!—Fingall!*"

Pierre raised his head towards the sound; then after a moment said:

"I know Fingall."

"And the woman? Tell me."

"And the girl. Fingall was such as Shon McGann, all fire and heart and devil-may-care. She—she was not beautiful except in the eye, but that was like a flame of red and blue. Her hair, too—then—would trip her, if it hung loose. That was all, except that she loved him too much. But women—*et puis*, when a woman gets a man between her and the heaven above and the earth beneath, and there comes the great hunger, what is the good? A man cannot understand, but he can see and he can fear. What is the good? To play with life, that is not much, but to play with a soul is more than a thousand lives. Look at Cynthie."

He paused, and Lawless waited patiently. He knew Pierre well.

Presently Pierre went on.

"Fingall was *gentil.* He would take off his hat to a squaw. It made no difference what others did; he didn't think; it was like breathing to him! How can you tell the way things happen? Cynthie's father kept the tavern at St. Gabriel's Fork, over against the great saw-mill. Fingall was foreman of a gang in the lumber-yard. Cynthie had a brother—Fenn. Fenn was as bad as they make, but she loved him, and Fingall knew it well, while he hated the young skunk. The girl's eyes were like two little fireflies when Fingall was about, and what he thought of her he said to me once: 'They are the kind God made for the whole year round.' He was a gentleman though he had only half a name—Fingall—like that! I think he did not expect to stay; he seemed to be waiting for something, for always when the mail came in he would be there, and afterwards you wouldn't see him for a time. So it seemed to me that he made up his mind to think nothing of Cynthie, and to say nothing."

"*Fingall!—Fingall! Oh, Fingall!*"

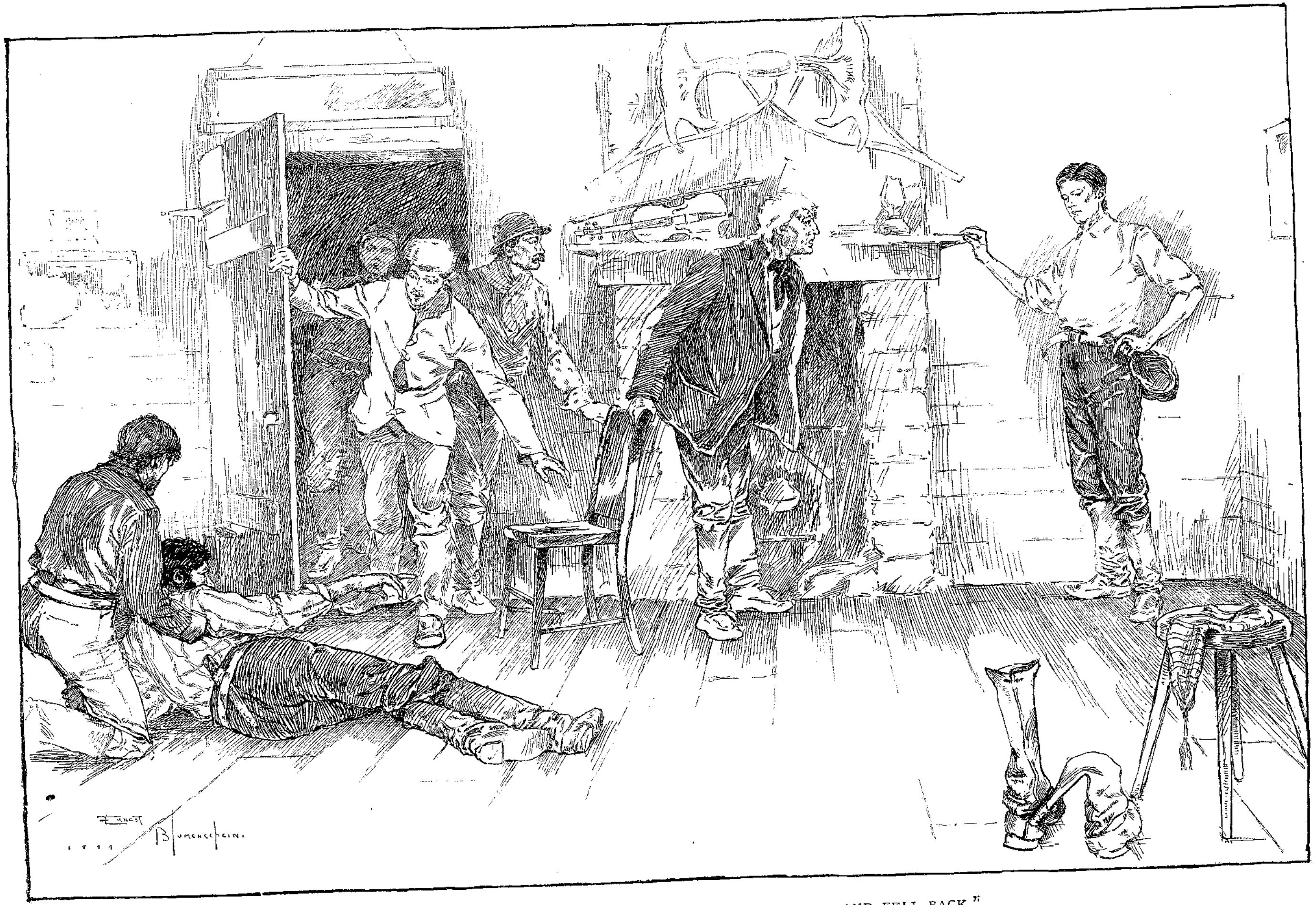
The strange, sweet, singing voice sounded nearer.

"She is coming this way, Pierre," said Lawless.

"I hope not to see her. What is the good?"

"Well, let us have the rest of the story."

"Her brother Fenn was in Fingall's gang. One day there was trouble. Fenn called Fingall a liar. The gang stopped piling. They expected the


ERNEST BLUMENSCHEIN

"HE LIFTED HIMSELF ON HIS ELBOW, POINTED AT FINGALL, AND FELL BACK."

usual thing. It did not come. Fingall told him to leave the yard, and they would settle some other time. That night there was a wicked thing. We were sitting in the bar-room when we heard two shots and then a fall. We ran into the other room. There was Fenn on the floor, dying. He lifted himself on his elbow, pointed at Fingall, and fell back. The father of the boy stood white and still a few feet away. There was no pistol showing—none at all. The men closed in on Fingall now. He did not stir; he seemed to be thinking of something else. He had a puzzled, sorrowful look. The men roared round him, but he waved them back for a moment, and looked first at the father, then at the son. I could not understand at first. Some one pulled a pistol out of Fingall's pocket and showed it. At that moment Cynthie came in. She gave a cry. I do not want to hear a cry like that often! She fell on her knees beside the boy, and caught his head to her breast. Then, with a wild look, she asked who did it. They had just taken Fingall out into the bar-room. They did not tell her his name, for they knew that she loved him.

"'Father,' she said all at once, 'have you killed the man that killed Fenn?'

"The old man shook his head. There was a sick color in his face.

"'Then I will kill him,' she said.

"She laid her brother's head down, and stood up. Someone put in her hand the pistol, and told her it was the same that had killed Fenn. She took it and came with us. The old man stood still where he was. He was like stone. I looked at him for a minute and thought, then I turned round and went to the bar-room. The old man followed. Just as I got inside the door, I saw the girl start back, and her hand drop, for she saw that it was Fingall. He was looking at her very strange. It was the rule to empty the gun into a man who had been sentenced, and already Fingall had heard his 'God, have mercy!' The girl was to do it.

"Fingall said to her in a muffled voice, 'Fire, Cynthie!'

"I guessed what she would do. In a kind of a dream she raised the pistol up—up—up, till I could see it was out of range of his head, and she fired. One! two! three! four! five! Fingall never moved a muscle. But the bullets spotted the wall at the side of his head. She paused after the five, but the arm was still held out, and her finger was on the trigger. She seemed to be in a dream. There were only six chambers in the gun, and, of course, one chamber was empty. Fenn had its bullet in his lungs, as we thought. Some one beside Cynthie touched her arm, pushing it down. But there was another shot; and this time, because of the push, the bullet lodged in Fingall's skull."

Pierre paused now, but waved with his hand towards the mist which now hung high up like a canopy between the hills.

"But," said Lawless, not heeding the scene, "what about that sixth bullet?"

"*Mon Dieu*, it is plain! Fingall did not fire the shot. His revolver was full every chamber when Cynthie first took it."

"Who killed the lad?"

"Can you not guess? There had been words between the father and the boy; both had fierce blood; the father in a mad minute fired. The boy wanted revenge on Fingall, and to save his father laid it on the other. The old man? Well, I do not know whether he was coward, or stupid, or ashamed—he let Fingall take it."

"And Fingall took it to spare the girl—eh?"

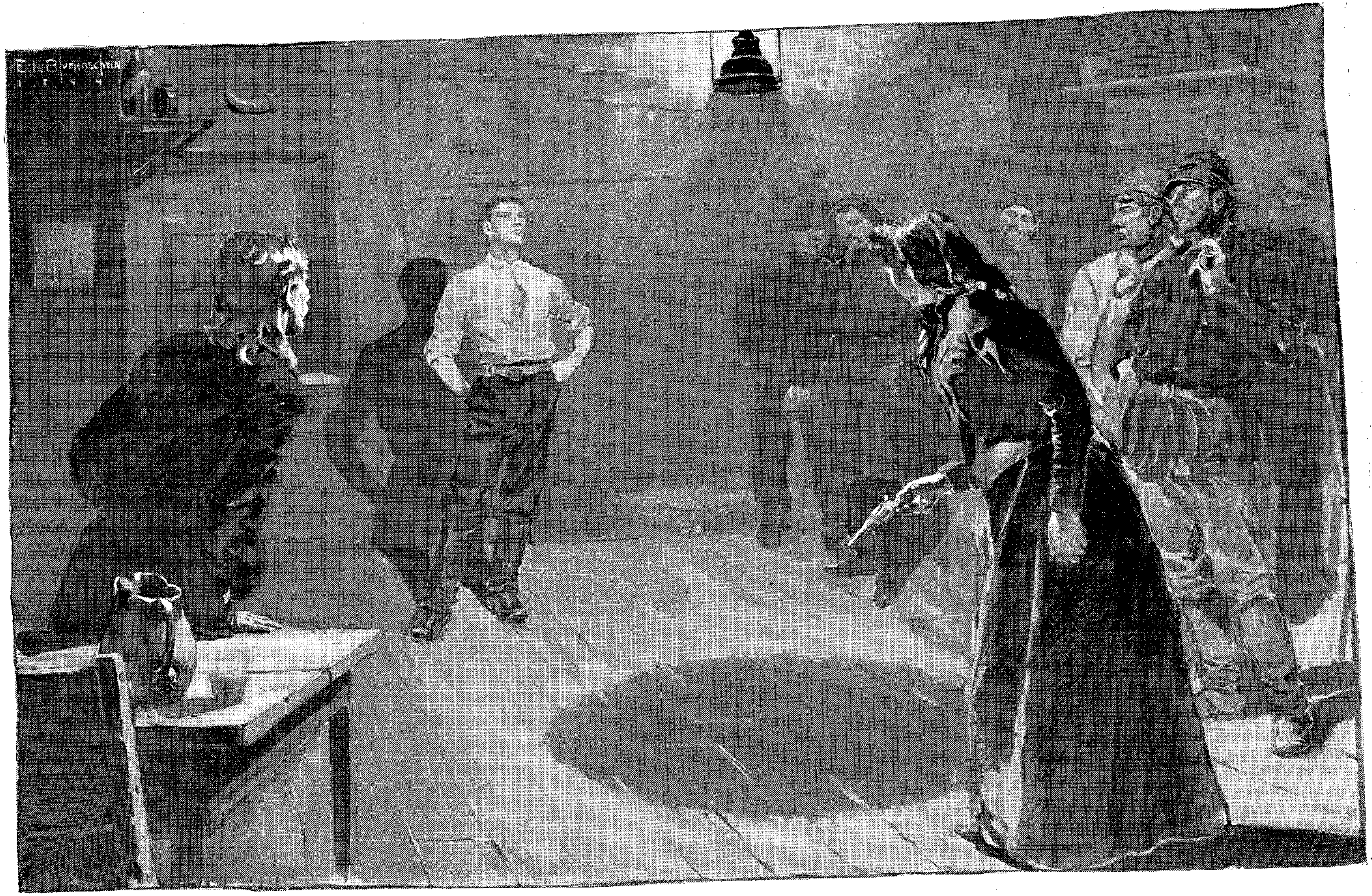
"For the girl. He knew it wasn't good for her to think that her father killed his own son."

"And what came after?"

"The worst. That night the girl's father killed himself, and the two were buried in the same grave. Cynthie——"

"*Fingall! Fingall!—Oh, Fingall!*"

"You hear? Yes, like that all the time as she sat on the floor, her hair about her like a cloud, and the dead bodies in the next room. She thought she had killed Fingall, and she knew now that he was innocent. The two were buried. Then we told her that


E. L. Blumenschein

"I SAW THE GIRL START BACK, AND HER HAND DROP, FOR SHE SAW THAT IT WAS FINGALL."

Fingall was not dead. She used to come and sit outside the door, and listen to his breathing, and ask if he ever spoke of her. What was the good of lyin'? If we said he did, she'd have come in to him, and that would do no good, for he wasn't right in his mind. By and by we told her he was getting well, and then she didn't come, but stayed at home, just saying his name over to herself. *Alors*, things take hold of a woman—it is so strange! When he was strong enough to go out, I went with him the first time. He was all thin and handsome as you can think, but he had no memory, and his eyes were like a child's. She saw him and came out to meet him. What does a woman care for the world when she loves altogether? Well, he just looked at her as if he'd never seen her before, and passed by without a sign, though afterwards there came trouble in his face. Three days later he was gone, no one knew where. That is two years ago. Ever since she has been looking for him."

"Is she mad?"

"Mad? It is not good to have one thing in the head all the time! What do you think? So much all at once! And then——"

"Hush, Pierre! There she is!" Lawless said, pointing to a ledge of rock not far away.

The girl stood looking out across the valley, a weird, rapt look in her face, her hair falling loose, a staff like a shepherd's crook in one hand, the other over her eyes, as she slowly looked from point to point of the horizon. The two watched her without speaking. Presently she saw them. She gazed at them for a minute, then descended to them. Lawless and Pierre rose, doffing their hats. She looked at both a moment, and her eyes settled, steadily glowing, on Pierre. Presently she held out her hand to him.

"I knew you—yesterday," she said.

Pierre returned the intensity of her gaze with one deep and strong.

"So—so, Cynthie!" he said. "Sit down and eat."

He dropped on a knee and drew a scone and some fish from the ashes. She sat facing them, and taking from a bag at her side some wild fruits, ate slowly, saying nothing. Lawless noticed that her hair had gone gray at her temples, though she was but one and twenty years old. Her face, brown as it was, shone with a white kind of light, which may or may not have come from the crucible of her eyes, where the tragedy of her life was fusing. Lawless could not bear to look long, for the fire that consumes a body and sets free a soul is not for the sight of the quick. At last she rose, her body steady, but her hands having that tremulous activity of her eyes.

"Will you not stay, Cynthie?" asked Lawless, very kindly.

She came close to him, and, after searching his eyes, said with a smile that almost hurt him: "When I have found him, I will bring him to your camp-fire. Last night the Voice said that he waits for me where the mist rises from the river at daybreak, close to the home of the White Swan. Do you know where is the home of the White Swan? Before the frost comes and the red wolf cries I must find him. Winter is the time of sleep. I will give him honey and dried meat. I know where we shall live together. You never saw such roses! Hush! I have a place where we can hide——"

Suddenly her gaze became fixed and dream-like, and she said slowly: "In all time of our tribulation, in all time of our wealth, in the hour of death, and in the day of judgment, good Lord, deliver us!"

"Good Lord, deliver us!" repeated Lawless in a low voice.

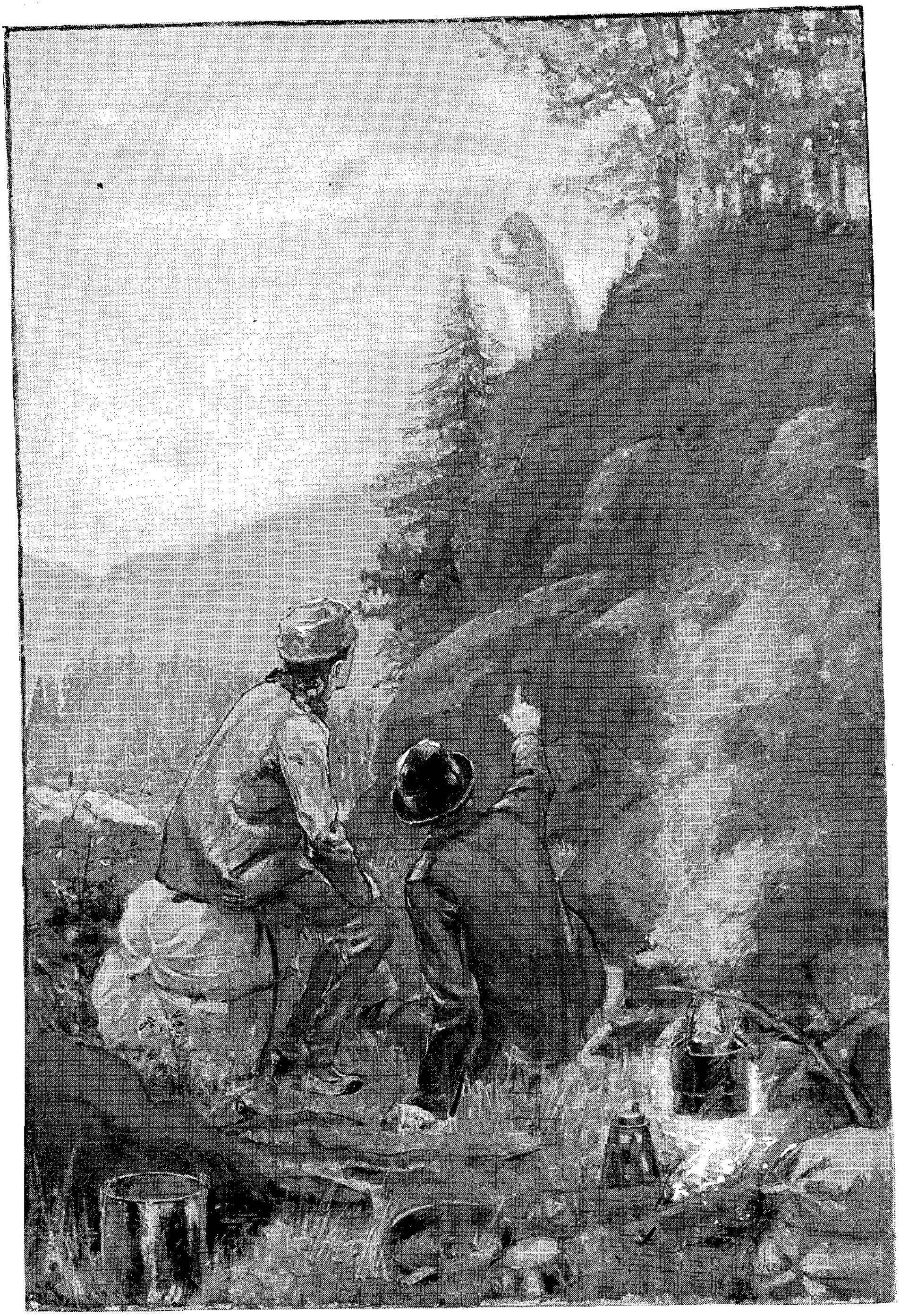
Without looking at them she slowly turned away and passed up the hillside, her eyes scanning the valley as before.

"Good Lord, deliver us!" again said Lawless. "Where did she get it?"

"From a book which Fingall left behind."

They watched her till she rounded a cliff and was gone, then they shouldered their kits and passed up the river on the trail of the wapiti.

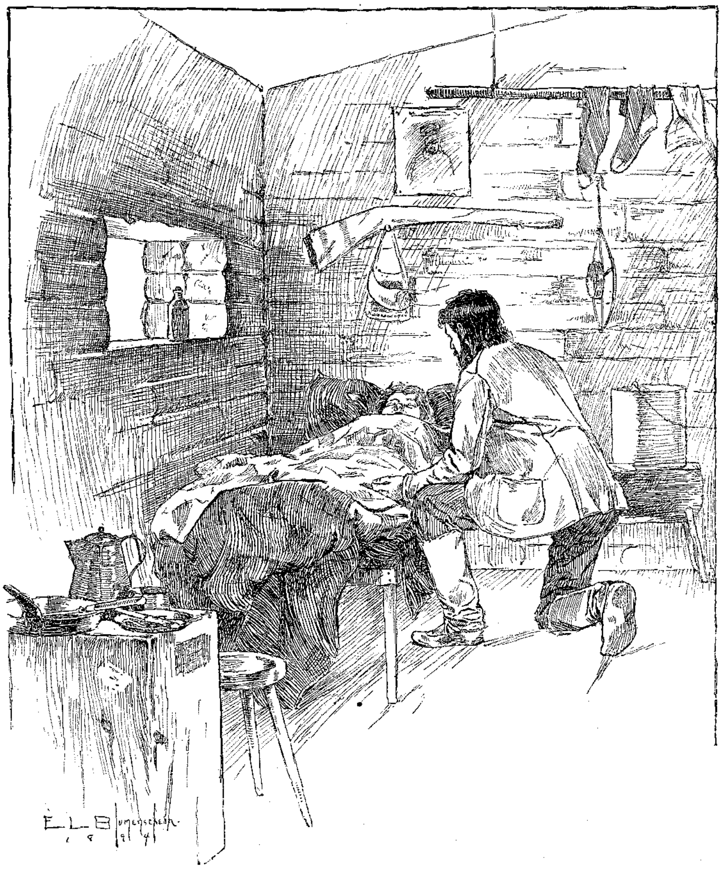
One month later, when a fine white surf of frost lay on the ground, and the sky was darkened often by the flight of the wild geese southward, they came upon a hut perched on a



"HUSH, PIERRE! THERE SHE IS!"

bluff at the edge of a clump of pines. It was morning, and Whitefaced Mountain shone solemnly clear, without a touch of cloud or mist from its haunches to its crown.

They knocked at the hut door, and in answer to a voice entered. The sunlight streamed in over a woman lying upon a heap of dried flowers in a corner, and a man kneeling beside her.



"A WOMAN LYING IN A CORNER, AND A MAN KNEELING BESIDE HER."

They came near, and saw that the woman was Cynthie.

Then Pierre broke out suddenly: "Fingall!" and caught the kneeling man by the shoulder. At the sound of his voice the woman's eyes opened.

"*Fingall!—Oh, Fingall!*" she said, and reached up a hand.

The bearded man stooped and caught her to his breast:

"Cynthie! Poor girl! Oh, my poor Cynthie!" he said.

In his eyes, as in hers, was a sane light; and his voice, as hers, said indescribable things.

Her head sank upon his shoulder, her eyes closed. She was asleep. Fingall laid her down with a sob in his throat, then he sat up and clutched Pierre's hand.

"In the East, where the doctors cured me, I heard," he said, pointing to her, "and I came to find her. I was just in time. I found her yesterday."

"And she knew you?" whispered Pierre.

"Yes; but the fever came hard after." He turned and looked at her, and, kneeling, smoothed away the hair from the smiling, pathetic face. "Poor girl!" he said. "Poor girl!"

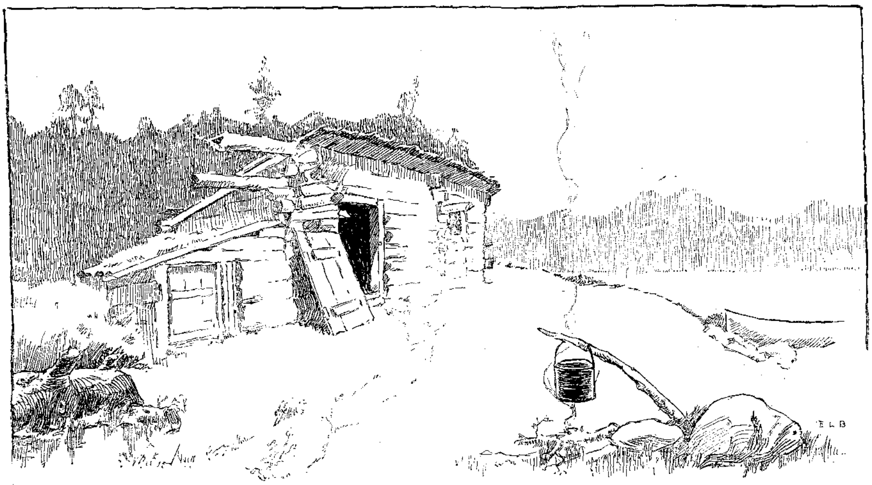
"She will get well?" asked Pierre.

"God grant it!" Fingall replied. "She is better—better."

Lawless and Pierre softly turned and stole away, leaving the man alone with the girl.

The two stood in silence, looking upon the river beneath. Presently a voice crept through the stillness. "*Fingall! Oh, Fingall!—Fingall!*"

It was the voice of a woman returning from the dead.



THE OPENING OF AN EMPIRE.

By Cy Warman.

MILLIONS of acres of land are lying idle in western Kansas and Nebraska, in Colorado, Wyoming, Utah, Nevada, Idaho, Montana, Arizona, New Mexico, and California, wanting only the magic touch of water to make them bloom into a flower garden, and yet producing nothing but lean coyotes, sun-dogs, and scenery. One million acres of land, worth one dollar and twenty-five cents per acre, or one million two hundred and fifty thousand dollars, if watered, would bring eleven million two hundred and fifty thousand. According to the estimates of Major Powell, there are one million square miles of these lands which need only water to render them productive. Special Agent Hinton estimates that there are seventeen million acres of arid lands which the general government could and should reclaim.

If we can add seventeen million acres to our cultivable domain, we shall increase our capacity for supporting a farming population as much as though we had absorbed one-third of the cultivated land of the United Kingdom, or one-fifth of that of France, or one-fourth that of Germany, or all the cultivated land of Sweden, Norway, and Greece put together. We can annex a Canada of our own without asking anybody's leave, and have a million acres to spare. We can have within our own borders as much cultivable land, in addition to our present two hundred and eight million acres, as Australia and Holland combined have under cultivation.

A CHANGE COMING.

The farm is more desirable than the poorhouse. It is better to "bug" potatoes than to walk in the rear ranks of an industrial army, receiving bayonets when you ask for bread. The reclamation of the arid lands, or a part of them, will open a new empire to our

A THREE YEAR OLD ORCHARD.

people. It will provide a new place where men may go and plant a vine and a fig tree. Here will they build a vast, uncrowded city in the open air, with ten-acre lots, and streets as long as a river. Think of the advantage of living in such an atmosphere, surrounded by such scenes as this new country will afford! What a change it would be to the thousands who are now breathing the bad air of the overfull cities! The editor of the "Irrigation Age," writing in the "Review of Reviews," says of this wondrous country: "In their rugged grandeur, in their multiform and fantastic shapes, in their variety and vividness of coloring, and in the wonder of their ever-changing aspect, the mountains of the arid West are the noblest works of Omnipotence. To see their snow-whitened summits outlined against the tender blue of a morning sky, or the golden glow of sunset, is to behold a poem that defies translation. And the valleys that nestle between these peaks are like jewels on fair hands." The opening of these lands will provide homes in the future for the thousands of people who, for the past twenty years, have been leaving the "God-made-country" and seeking the man-made town.

And when all the acres between the Rocky Mountains and Kansas are under cultivation by a system of irrigation, as they are sure some day to be, there will no more hot winds go thirsting over the cornfields of Kansas and Nebraska. The moisture from these irrigated fields would so temper the dry winds that they would come to the Kansas farmer as soft as the winds from the sea; and the sun-parched plain, where now scarcely enough grass grows to pasture a grasshopper, will, when watered, be transformed into one great garden.

The demand for Eastern products of agriculture in the Rocky Mountain States is increasing faster than the supply, and already these States furnish a larger market for such products than Cuba, Port Rico, Central America, and South America combined. Of the one hundred and thirty-one million dollars in gold, silver, copper, and lead produced in the mountain States in 1890, fifty million dollars went to the Eastern States for manufactured articles, and thirty million dollars for agricultural products, chiefly grain and fruit. No small amount went East as dividends to stockholders whose money has helped largely to develop the mines of the West. These figures are the certain assurance of good returns for all investments that may be made in agricultural development and in manufacturing enterprises.

Certain it is that the great tide of humanity which for the past two decades has been running into the cities must now begin to flow back. The factories and shops of the East are idle, not from any political misfortune, but because the building of railroads and towns in the West has ceased.

When Nebraska was "booming," when Kansas was constructing her nine thousand miles of railroad, and building a county seat every evening where the track ended, the factories were kept busy. Now this work is completed, and labor is without employment.

THE IRRIGATED FARM THE ONLY SURE FARM.

The irrigated farm is the only "sure-thing" farm on the face of the earth. Here a man may, for the small sum of one dollar an acre, make it rain or shine on any or all of his acres when he wills. An irrigated farm never wears out.

There are farms in New Mexico that have been irrigated for two hundred and fifty years, and they are to-day as good as new. The Pima Indians of Arizona, we are told, have cultivated the same lands for five hundred years, and nothing has been applied but the water which freshened and fertilized the fields. In Egypt there are farms four thousand years old that are kept rich by the new soil and sediment carried to them every season through the irrigating ditches.

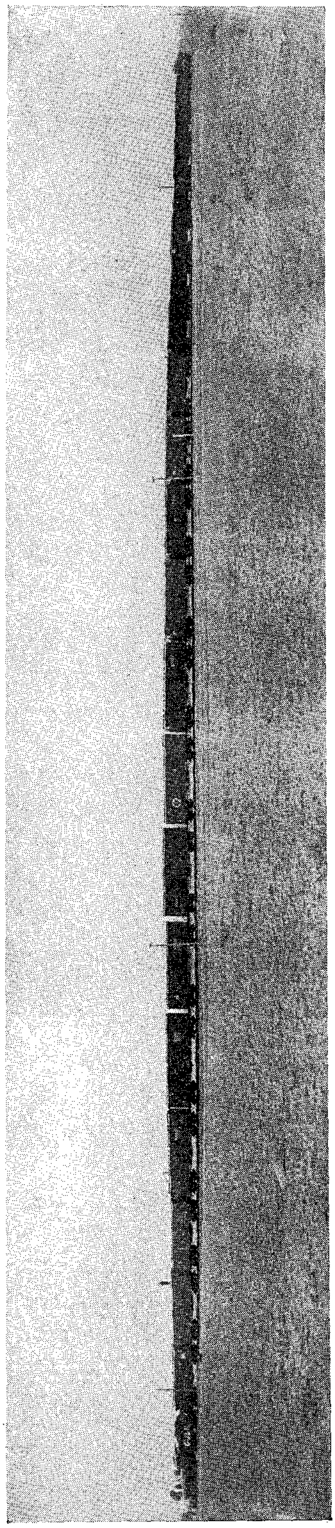
What can be accomplished by irrigation has been demonstrated in northern Colorado, the garden spot of the West, if not of the world. T. De Witt Talmage, having seen this garden which has been planted in the desert wastes of a waveless sea, returned to Brooklyn and preached a sermon on irrigation, saying: "About eight hundred millions of people of the earth to-

GROWN
2 MILES
OF DENVER
POST OFFICE.

A RECENT FRUIT EXHIBIT IN DENVER.

day are kept alive on food raised on irrigated ground; and here we have allowed to lie waste, given up to rattlesnakes, prairie dog, and bat, land enough to support whole nations of industrious population.

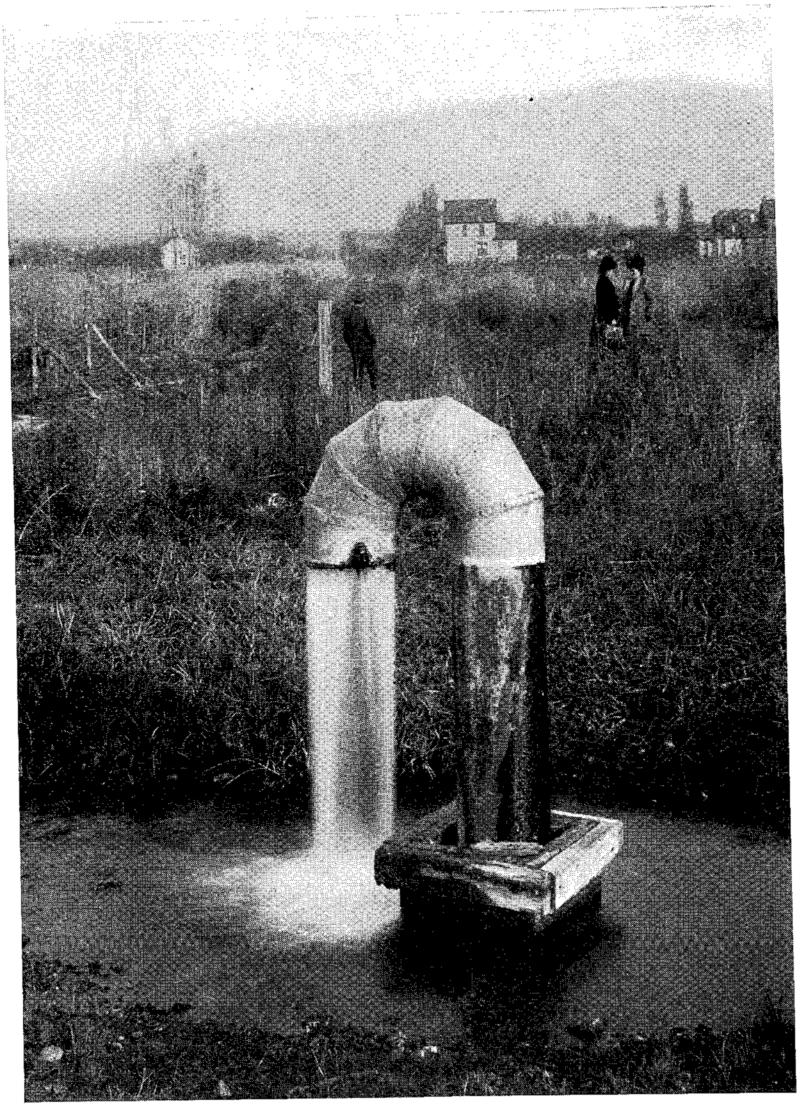
"Experiments have proven that ten acres of irrigated land will produce as much as fifty acres here where we rely upon the rainfall. We have our freshets and our droughts, but in those lands that are to be scientifically irrigated, there will be neither freshets nor droughts. As you take a pitcher, get it full of water, set it on the table, and drink from it when you are thirsty, and never think of drinking a whole pitcherful at once, so will Colorado catch the rain in the rainy season, take up the waters of her rivers in great pitchers of reservoirs, and from them refresh herself whenever she wills."



POTATO TRAIN ON THE UNION PACIFIC, DENVER AND GULF RAILWAY.

Dr. Talmage's estimate of the productiveness of irrigated ground is a very nearly correct one. The splendid homes and thriving villages along the line of the Union Pacific, Denver and Gulf Railroad are the result of irrigation. These farmers take no chances. There is no such thing as a failure in crops. The country merchant knows what to depend upon. It is a common thing to see a solid train of potatoes, wheat, or flour, winding along in the shadow of the Rocky Mountains in the direction of Denver, the great distributing point.

If the men who followed Frémont over the sands of this sun-dried sea could get but a glimpse of the glorious country as it is to-day, great would be their surprise. Where then the cheerless wind swept through the sage brush; where the horned toad and the rattlesnake hurried from the trail; where half-starved wolves seemed to hang on the edge of the world and cry in the night for something to die where nothing could live—bright June roses bloom to-day. The broad canal sweeps down the plain, and the music of running water comes up from every roadside and mingles with the music made by the meadow lark. The winds are softer now, and bring to the traveller at the palace-car window the sweet fragrance of the fields, and the scent of apple orchards already in bloom. The busy farmer is making furrows in the brown fields where the seed is sown. The lazy cattle are cropping the clover, leaving the white blossoms for the bees, already busy in the honey harvest. The farmer's wife bustles about, setting hens and onions, and settling little disputes between the children. Crooked-legged calves caper in



ARTESIAN WELL IN LIBERTY PARK, SALT LAKE CITY. FROM A PHOTOGRAPH BY S. H. COCKWELL, SALT LAKE CITY.

the corrals, and soft furred colts with bushy tails follow the farm wagons down the dusty road. Such are the scenes in northern Colorado to-day, where Frémont found heaps of dust and a wild desert.

COLORADO'S FIELDS OUTVALUE HER MINES.

If all Colorado's gold, silver, lead, and copper mines were closed forever, it would not be half so hard on the State as would be the failure of her fields to produce. The drying up of her irrigating canals would cost the people four dollars for every dollar they would lose by the closing of all the silver mines in the State. Even residents have but a faint idea of the wonderful resources of the State and the fertility of the soil.

The area embraced in the irrigated counties of Arapahoe, Jefferson, Boulder, Larimer and Weld, is of itself an empire of wealth. In this area are one thousand two hundred irrigating ditches, with an aggregate length of three thousand five hundred miles, and covering one million one hundred thousand acres of land, of which at least seven hundred thousand acres are actually irrigated and cultivated. It had, according to the last census, a population of one hundred and seventy-six thousand one hundred and fifteen, but the population can now be safely stated at two hundred thousand, or nearly one half the population of the State. In the five counties named are three hundred and fifty schoolhouses, and school property valued at three million dollars. There are seven hundred and twenty-five miles of railway within the same area, or about one-fifth of the entire mileage of the State. The assessed value of property in the district is one hundred and twenty-four million three hundred and twenty-seven thousand two hundred and fifty-nine dollars—more than one half the whole assessment of the State, and indicating an actual wealth of three hundred and seventy-three million dollars.

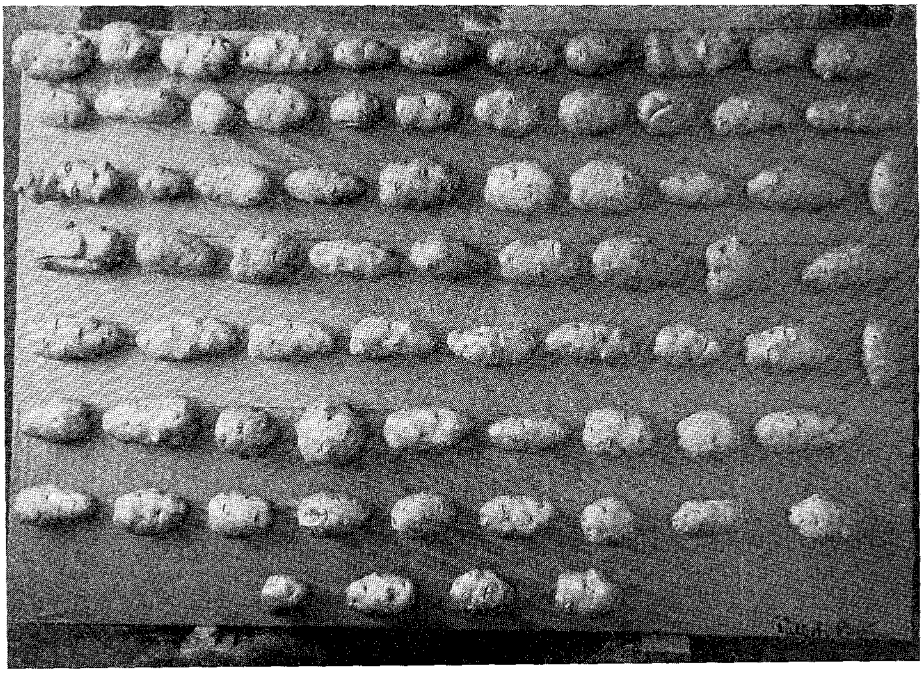
There are no gold or silver mines in this section.

The potato crops of this district are simply wonderful. Mr. J. B. Swan, in 1893, experimented with over fifty varieties of potatoes. The smallest yield per acre was from the American Giant, one hundred and twenty-four bushels. The largest was from the Alexander Prolific, seven hundred and ninety-eight bushels per acre. The Bill Nye brand yielded five hundred and thirty-three bushels.

The agent's books in the office of the Gulf road, at Greeley, show that two thousand and fifty-nine carloads of potatoes have been shipped from that station so far, from the crop of 1893, and he estimates that the shipping from the whole crop will be twenty-five hundred cars. All these potatoes grow within a radius of ten miles of Greeley. Although fruit and grain grow abundantly here, potatoes are the principal product.

A little way to the south are the great wheat fields, covering a strip of territory one hundred miles long and twenty miles wide, making a beautiful beach to the desert sea.

Strange as it may seem, within this favored territory, along the streams,



POTATOES GROWN IN 1893 BY J. B. SWAN, LOVELAND, COLORADO. PHOTOGRAPHED UPON A BACKGROUND FOUR FEET BY SIX FEET.

A UTAH CABBAGE FIELD—EIGHT THOUSAND HEADS TO THE ACRE.

or wherever the plain is rough and broken, are apparently inexhaustible coal beds. There are also gypsum beds, quarries of beautiful building stone, and marvellously beautiful granite.

COLORADO FRUIT-GROWING.

The fruit-growing industry of Colorado has practically sprung into commercial importance within the past five years. The peach belt on the western slope was, a little over eleven years ago, the home of the Ute Indian. It has been proved that in altitudes ranging from four thousand three hundred feet to seven thousand feet, all of the deciduous fruits flourish and yield abundantly in that favored belt.

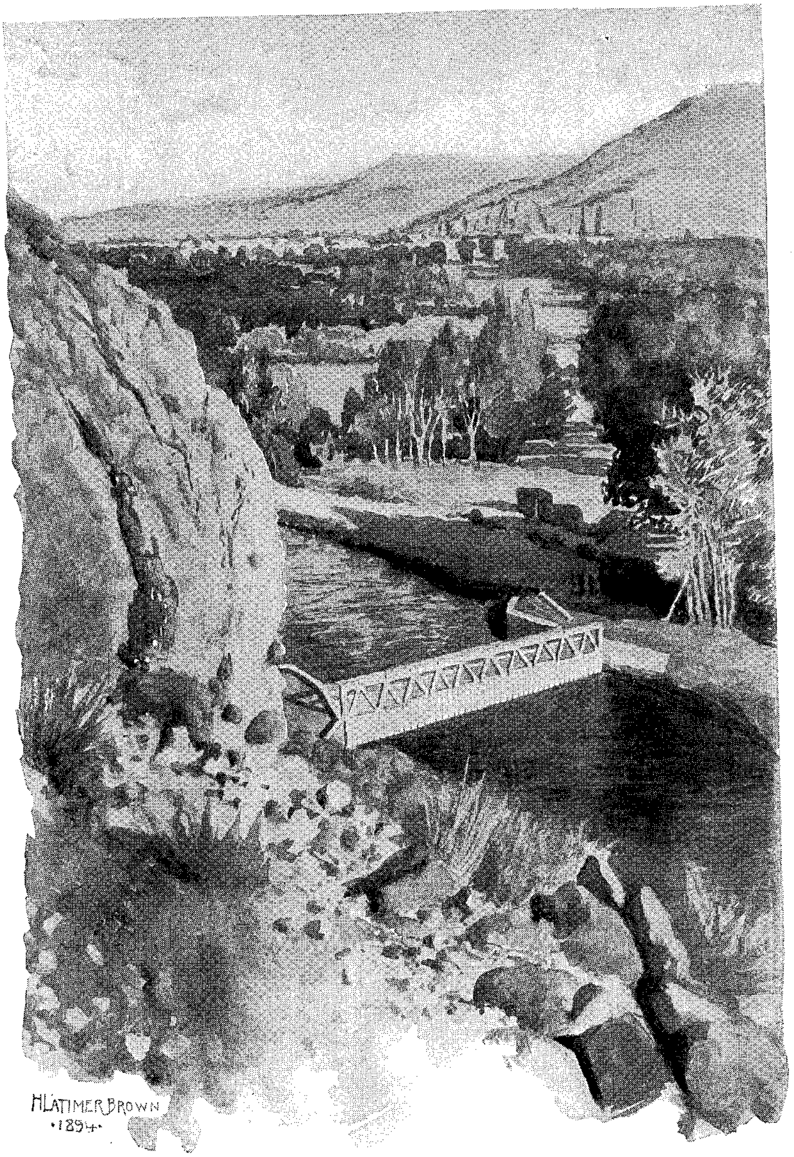
Results show that apples, prunes, peaches, nectarines, apricots, grapes (including all of the noted California varieties), plums, cherries, and all the bush or small fruits are exceedingly profitable, netting from three hundred to five hundred dollars an acre, according to locality and skill in growing. Peach orchards only eleven years old have borne eight consecutive crops, and offer an equally good prospect for bearing again this year. A warm trade wind makes frost practically unknown between the months of March and November in this locality.

On the eastern slope of the State lies what is known as the apple belt, for the reason that the greatest success has been attained in growing apples, though many other kinds of fruit also flourish to a profitable extent. A case in point, illustrating this, is the fact that one grower at Cañon City derived one thousand five hundred barrels of apples from five acres of land, and they brought five thousand eight hundred dollars, or a trifle less than an average of four dollars per barrel.

This is not an isolated example representing the highest possible result, but is given to show what can be done with good average care in the right kind of soil.

Illustrating the profits of other fruits, one man near Denver secured one thousand two hundred dollars from a single acre of grapes, while another received five hundred dollars an acre from berries. Others have received as high as one thousand dollars an acre. Another grower, within a few miles of Denver, harvested from two acres one hundred and twenty barrels of apples from five-year-old trees, and thirty

A UTAH CELERY FIELD—TWO THOUSAND FIVE HUNDRED STALKS TO THE ACRE.



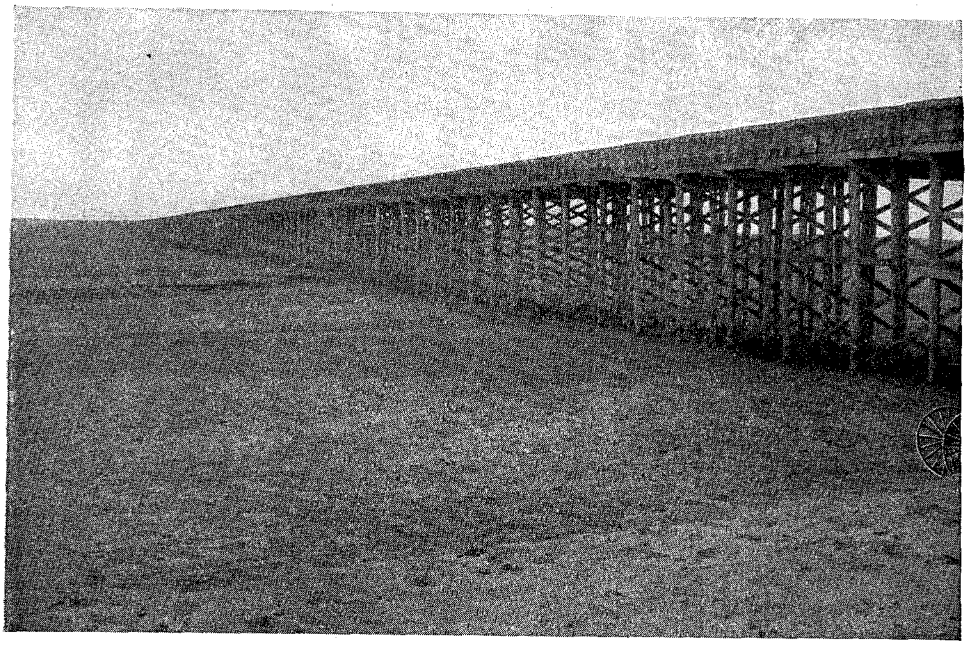
THE HEAD GATE OF THE RIO GRANDE CANAL, SAN LUIS VALLEY, COLORADO.

thousand quarts of berries from seven and a half acres of ground.

The census returns for the decade ending 1890 show that eleven thousand eight hundred and eighty-three acres more of fruit were planted in Colorado during that time than in the preceding decade, with an increase of two hundred and sixty-four per cent. on production. Yet the product of 1893, two million two hundred and fifty thousand dollars, was but a small part of the home demand, and importations to supply the deficiency were made during that time amounting to about four million five hundred thousand dollars, nearly one-half of which was for green and the remainder for canned and dried fruits.

A barrel of apples is worth more than a barrel of flour. Two barrels will bring more than a pound of silver.

The ten thousand irrigated farms in Utah average twenty-seven acres to



FLUME OF THE FORT MORGAN (COLORADO)

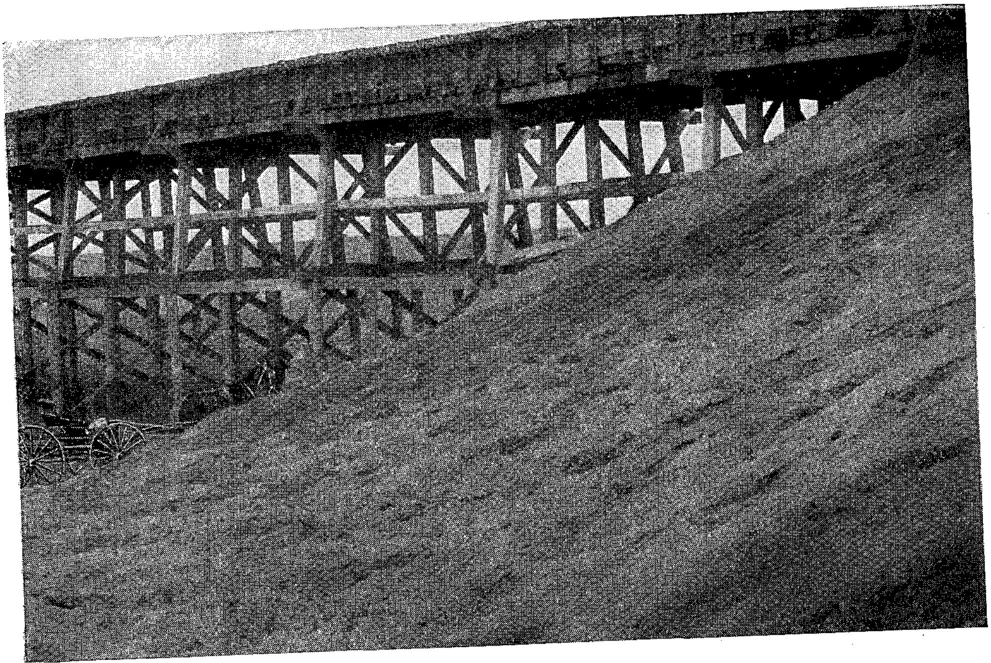
the farm, and judging from what I have seen, about an equal number of children. None of the young men of Utah are enlisting in the army of the unemployed.

THE DUTY OF GOVERNMENT RESPECTING ARID LANDS.

A large proportion of the arid land is public domain, and authorities differ as to what the United States government should do with it. At an irrigation convention held at Helena, Montana, the one hundred and ninety-four delegates voted that Montana did not want the arid lands within her limits given to the State. But Professor Stanton believes this should be done; that such lands should be ceded to the States. Mr. Hinton, who was the special agent of the Senate Committee on Irrigation, is of the same opinion. Major Powell does not believe that the government will do anything toward the reclamation of the desert lands of the West. Senator Warren would grant the lands to the States and Territories. Senator Carey has, at this time, a bill before the United States Congress which provides for the cession, on the part of the government, of one million acres to each of the arid land States.

Mr. T. C. Henry, who has made the subject of irrigation his life-long study, says: "If all the water of all the streams in Colorado were absolutely conserved for irrigating purposes, and applied with the skill and economy displayed in southern Europe, every acre of this immense area would be made fruitful, and support an agricultural population, urban and rural, of five millions of people, and then be less than half as densely populated as Belgium or the agricultural districts of France.

"Within the next half century the farming lands of Colorado will have become worth from one to two hundred dollars an acre. . . . As the general government owns and controls the public lands, valueless without water, it is but right and proper that it should take the measurement of the capacity of the public streams, make elaborate surveys, run levels and contour lines, locate reservoir sites, and provide estimates for the widest possible utilization of the land and water unoccupied and yet unappropriated. . . . Upon repayment, perhaps, of



CANAL. FROM A PHOTOGRAPH BY L. G. CARPENTER.

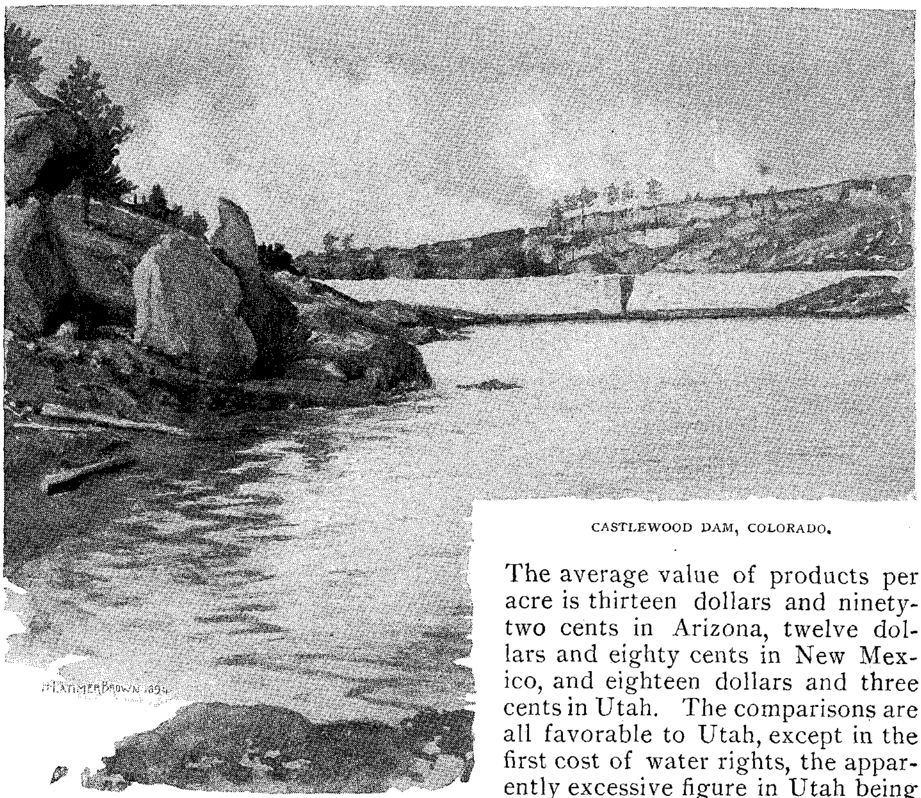
such cost, the non-mineral agricultural lands should be granted to the State by the Federal government, conditioned upon their occupancy and improvement. Should the general government undertake the construction and operation of such enterprises? I think not. . . . Private or corporate capital should project and control such enterprises, upon which depends the future of our agricultural interests. . . .

"The organic law of Colorado does not recognize what in the East are known as the riparian rights. The stream coursing through the demesne of a private landholder no more belongs to him than the air which is wafted over it. Unless he make an actual application of the water for a beneficial use upon his land, he could not withhold it from any neighboring landowner who himself thus appropriates the water, and who may for that purpose enter upon the property of the former, dig his irrigating canal, and carry away the water to his farm. Of course, thus exercising the right of eminent domain, he must condemn the right of way and pay what the damages amount to—but never anything for the water itself.

"Under the laws of Colorado, irrigating canals built by corporate capital are common carriers of water, and in no sense owners of it. Intelligently directed canal companies exert themselves to dispose of the water they carry to those who actually apply it, or they themselves make such application upon land they procure for that purpose. As our statutes now are, no canals will be built for the purpose of merely renting water, but water companies will sell perpetual water rights attached to specified tracts of land, and representing a specific quantity of water, and subject to such an annual charge for maintenance and operation as will forever operate the canal when all the rights are sold and thus assessed."

THE COST OF IRRIGATION.

While picturing this poor man's paradise, we should not forget that it affords equal opportunities for the legitimate employment of capital. The returns of the census of 1890 show that the first cost of irrigated lands, with their water rights, had been seventy-seven million four hundred and ninety thousand dol-



CASTLEWOOD DAM, COLORADO.

lars, and that their value at the time the census was taken was two hundred and ninety-six million eight hundred and fifty thousand dollars, an increase of about two hundred and eighty-three per cent. The estimated value of all the gold and silver mines in the United States, including their railroads and other improvements, was only about one-half greater than that of the irrigated lands.

There are two hundred and sixty-three thousand four hundred and seventy-three irrigated acres in Utah, sixty-five thousand eight hundred and twenty-one in Arizona, and ninety-one thousand seven hundred and forty-five in New Mexico. The first cost of water in Arizona is seven dollars and seven cents an acre; in New Mexico, five dollars and fifty-eight cents; and in Utah, ten dollars and fifty-five cents. The annual cost of water is one dollar and fifty-five cents an acre in Arizona, one dollar and fifty-four cents in New Mexico, and ninety-one cents in Utah. The average value of products per acre is thirteen dollars and ninety-two cents in Arizona, twelve dollars and eighty cents in New Mexico, and eighteen dollars and three cents in Utah. The comparisons are all favorable to Utah, except in the first cost of water rights, the apparently excessive figure in Utah being due to the manner in which the canals and ditches were built.

A great deal of land throughout the West is irrigated by artesian wells, but artesian water is not the best for irrigating purposes. In the first place, it is too cold, unless run through long ditches, or held for a time in reservoirs. And it lacks the ammonia and mineral substances contained in snow-water, and so necessary to vegetable life.

Probably the greatest artesian well in the world has been recently struck in South Dakota. It is nine hundred and sixty feet deep. The water pressure is two hundred and twenty-five pounds per square inch, and its flow is from eight thousand to ten thousand gallons per minute.

A number of farmers in the San Luis valley are irrigating from artesian wells, chiefly because they are cheaper than ditches. Here a good flow of water may be obtained at an average depth of one hundred feet, costing twenty-five dollars a well.

They have in this valley, through

"McFARLAND'S TWINS."—GROWN ON IRRIGATED GROUND NEAR DENVER which flows the beautiful Rio Grande, what is known as the Henry system of canals, four in number, with an aggregate main mileage of two hundred and thirty-seven miles. There are two thousand miles of laterals, and the whole system has cost one million one hundred and sixty thousand dollars.

The soil and climate are especially adapted to the culture of potatoes and all kinds of vegetables. A great deal of wheat is grown in the lower valley. Alfalfa is a profitable crop, and oats yield from sixty to one hundred bushels to the acre.

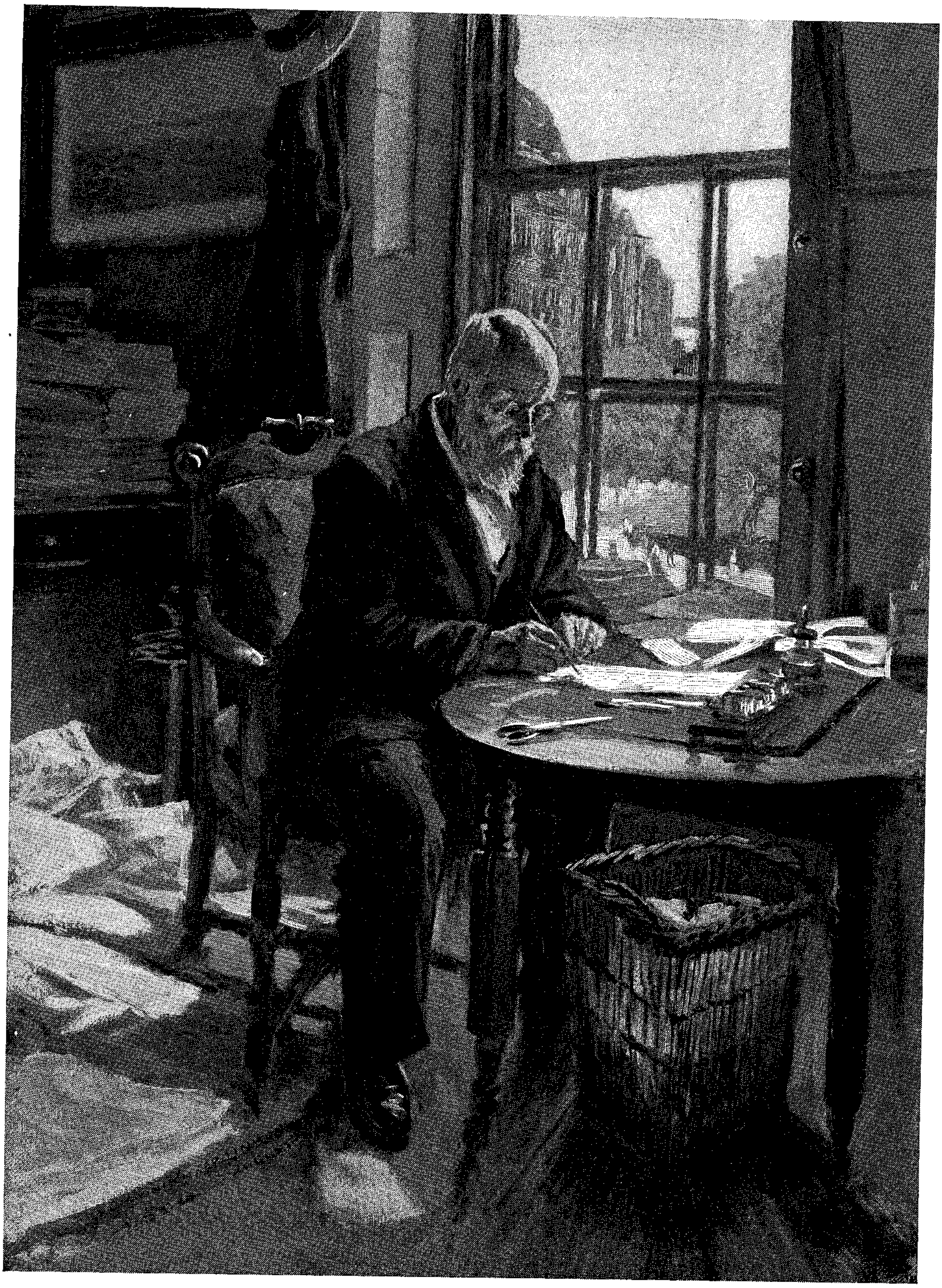
DAMS AND RESERVOIRS.

Some of the biggest dams in the world are in California. The Merced dam is sixty feet high, with a capacity of five billion five hundred million gallons, spread over six hundred and fifty acres. The Sweetwater dam, near San Diego, is ninety feet high, and has a capacity of six billion gallons, covering seven hundred and twenty-five acres; and the Bear Valley dam is sixty feet high, with a capacity of ten billion gallons, covering two thousand two hundred and fifty acres.

Immense irrigating canals are now under construction in Colorado. Ex-Governor Eaton is just completing a great reservoir, the waters of which will cover eight hundred acres of land, and are expected to irrigate a whole township. The largest canals and reservoirs in Colorado are on the Arkansas River. The La Junta and Lamar canal and reservoir system is a vast irrigation enterprise. The canal has a bottom width at headgate of thirty feet, and carries water seven feet deep. It is one hundred and fourteen miles long —the longest in the United States— and has a combined lateral length of seven hundred and fifty miles. It has several reservoirs, two of which are named the King and the Prince. The former has an area of one thousand acres, a gross depth of forty feet, and holds eight hundred and sixteen million cubic feet of water. The Prince reservoir covers an area of three hundred and fifty acres, with a gross depth of water of seventeen feet. Its total capacity at one filling is fifty million cubic feet. The system cost three hundred thousand dollars.

Reservoir No. 1, on the Colorado Canal, has an area of six hundred acres, with a capacity of one hundred and thirty-three million eight hundred and ninety thousand cubic feet of water. No. 2 has an area of two thousand five hundred acres, and a capacity of six hundred and sixty-five million eight hundred and eighteen thousand six hundred and twenty cubic feet. Reservoir No. 3, projected but not completed, has the greatest capacity of any reservoir site yet recorded in Colorado. Its area is twenty square miles, and its capacity sixteen billion three hundred and twenty million cubic feet. Lake Lolila, a natural depression under the same grand system, has a capacity of seventy-five million four hundred and sixty-seven thousand seven hundred cubic feet. The other reservoir sites of this scheme have areas from four hundred to five thousand acres. It is the most gigantic storage system in the State. It cost upward of four hundred thousand dollars.

One of the most favored spots in the arid West is the Pecos Valley, New Mexico. Less than half a dozen years ago the Eddy brothers, two young New Yorkers, settled on the Rio Pecos. Now there is Eddy County, with the town of Eddy as the county seat, a railroad connecting with the Atlantic and Pacific, churches and schoolhouses, a magnificent hotel, and one of the most extensive systems of irrigation east of California. There are already in operation one thousand two hundred and forty-nine miles of canals and ditches, a half dozen reservoirs, one of which is said to be the largest in America, covering eight thousand one hundred acres of ground, and holding six billion cubic feet of water. The Pecos Valley Railroad, which was projected by Mr. J. J. Hagerman and the Eddy brothers, is to be extended ninety miles north this year. New as the country is, one man has six hundred and forty acres of grapevines that will bear grapes this year. They were set out in the spring of 1892.



CHARLES A. DANA IN HIS OFFICE AT "THE SUN."

(Drawn from life by Corwin Knapp Linson.)